AUTOMOTIVE INDUSTRIES

AUTOMOTIVE and AVIATION MANUFACTURING
ENGINEERING • PRODUCTION • MANAGEMENT

MARCH 1, 1954

In This Issue

A CHILTON PUBLICATION

This little red wagon presented a big drawing problem!

A Standard engineer's advice helped cut rejects by over 90%!

At Steger, die cleaning is of major importance because a single scratch can result in torn or ruined bodies during the processing. STANICOOL HD safely reduces the time-consuming die cleaning operation to an *effective* minimum.

■ The Steger Products Manufacturing Company (Steger, Illinois) manufactures children's wagons. Of the 8-hour shift capacity of 1600 to 1800 wagon bodies, up to 20% formerly wound up as rejects, and the dies had to be cleaned after every 10 to 15 bodies.

Six years ago a Standard Cutting Oil Engineer suggested STANICOOL HD. Today it's still on the job—the reject rate reduced to less than 10 a day. Die breakage is down to almost nothing; dies are cleaned only once or twice daily. Again, Standard Oil's metalworking products prove they can do the hard jobs better!

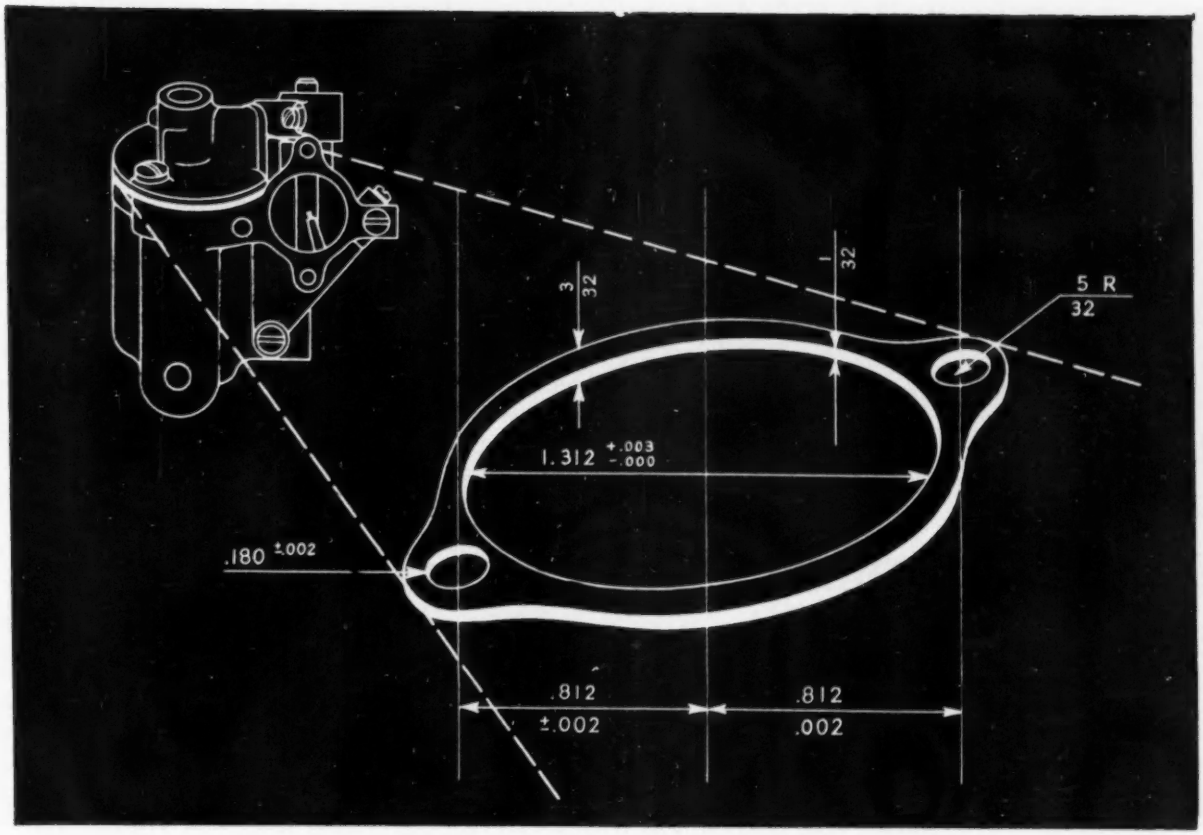
STANICOOL HD Soluble Oil—for cutting and grinding operations and for certain forming operations. Mixes readily, non-irritating, anti-rust. Call on the services of your Standard Oil Cutting Oil Engineer. Write Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois, to secure the services of the Standard Cutting Oil Engineer nearest you.

STANDARD

STANDARD OIL COMPANY

(Indiana)

A complete line of metalworking products including: STANICUT Cutting Oils—STANOSTAMP Compounds—SUPERLA Quenching Oil.



New fiber gasket solves corrosion problem

When choosing gaskets, it's well to consider that gaskets sometimes cause trouble in other ways than by leakage.

Take the case of the carburetor shown above. Examination of carburetors returned to the factory showed that corrosion was the major reason for complaints. The cause of this was traced to the float bowl cover gasket. The glue-glycerine saturant in this treated fiber gasket absorbed moisture and permitted electrolytic action between the zinc and aluminum die castings and adjoining brass parts.

The manufacturer found a solution to his problem in an entirely new type of fiber gasketing—Armstrong's Accopac®. Accopac contains no hygroscopic agent; it does not encourage electrolytic action. Accordingly, when Accopac CN-705 was put in service on this carburetor, corrosion complaints dropped to zero.

Fibers locked in rubber. Why doesn't Accopac absorb water? The answer lies in the way it's made—a new beater saturation process that covers each fiber in an Accopac sheet with rubber latex *before* the sheet is formed. This locks the fibers in a uniform, closely controlled rubber coating. The resulting sheets are tight, impervious, and relatively unaffected by high humidity.

Today, Accopac has found wide acceptance wherever there's a need for efficient sealing at low cost. This new material is used in pumps, engines, automatic washers, aircraft and automotive equipment, and a wide variety of other applications.

FREE 24-PAGE GASKET MANUAL. Send for "Armstrong's Gasket Materials," 1954 edition. Contains information on specifications, tolerances, joint design, etc. See it in Sweet's product design file. For your own copy, write today to the Armstrong Cork Company, Industrial Division, 7004 Imperial Ave., Lancaster, Penna.

ARMSTRONG'S ACCOPAC

High Strength Nickel Alloyed Steels give greater play to the skill of the automotive engineer, because these nickel-containing steels have greater stamina and toughness as well as resistance to wear, shock, fatigue and corrosion. Send us details of your metal problems for our suggestions.

Black Diamond

cuts deadweight . . . adds load capacity

"We manufacture the lightest steel trailer ever built" . . . states the Black Diamond Trailer Company, Inc. of Bristol, Va.

Weight reduction obviously brings basic advantages to trailer users, because less deadweight allows greater payload and, correspondingly, an increase in revenue. Secondary advantages are that every pound trimmed off saves fuel and reduces wear on tires and brakes. As a result, operating costs go down.

To reduce weight without sacrificing safety, Black Diamond uses thin, light sections of high strength, low alloy steel containing nickel.

Nickel alloyed steels of this type provide the same strength as thicker, heavier sections of plain carbon steel. Compared to carbon steels adjusted to provide equal tensile strength, the nickel alloyed steels show superior behavior in fabrication, including welding and cold-forming.

In addition, these nickel alloyed steels resist abrasion and erosion as well as many types of corrosion, and thus lengthen equipment life substantially. Produced under various trade names by leading steel companies, these high strength steels containing nickel along with other alloying elements, provide three basic advantages:

1. High strength, in the as-rolled condition, permitting important weight reductions.

2. Excellent response to usual fabrication operations, including easy forming and welding.

3. Good resistance to corrosion, abrasion and impact.

Consult us on the use of these high strength, nickel alloy steels in your products or equipment. Write us, today.

INCO

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

A CHILTON MAGAZINE **AI** PUBLISHED SEMI-MONTHLY

AUTOMOTIVE INDUSTRIES

MARCH 1, 1954 VOL. 110, NO. 5

FEATURES

NEWS PREVIEWS

DEPARTMENTS

AUTOMOTIVE INDUSTRIES is a consolidation of The Automobile (weekly) and the Motor Review (weekly) May, 1902; Dealer and Repairman (monthly), October, 1903; the Automobile Magazine (monthly), July, 1907, and the Horseless Age (weekly), founded in 1895, May, 1918.

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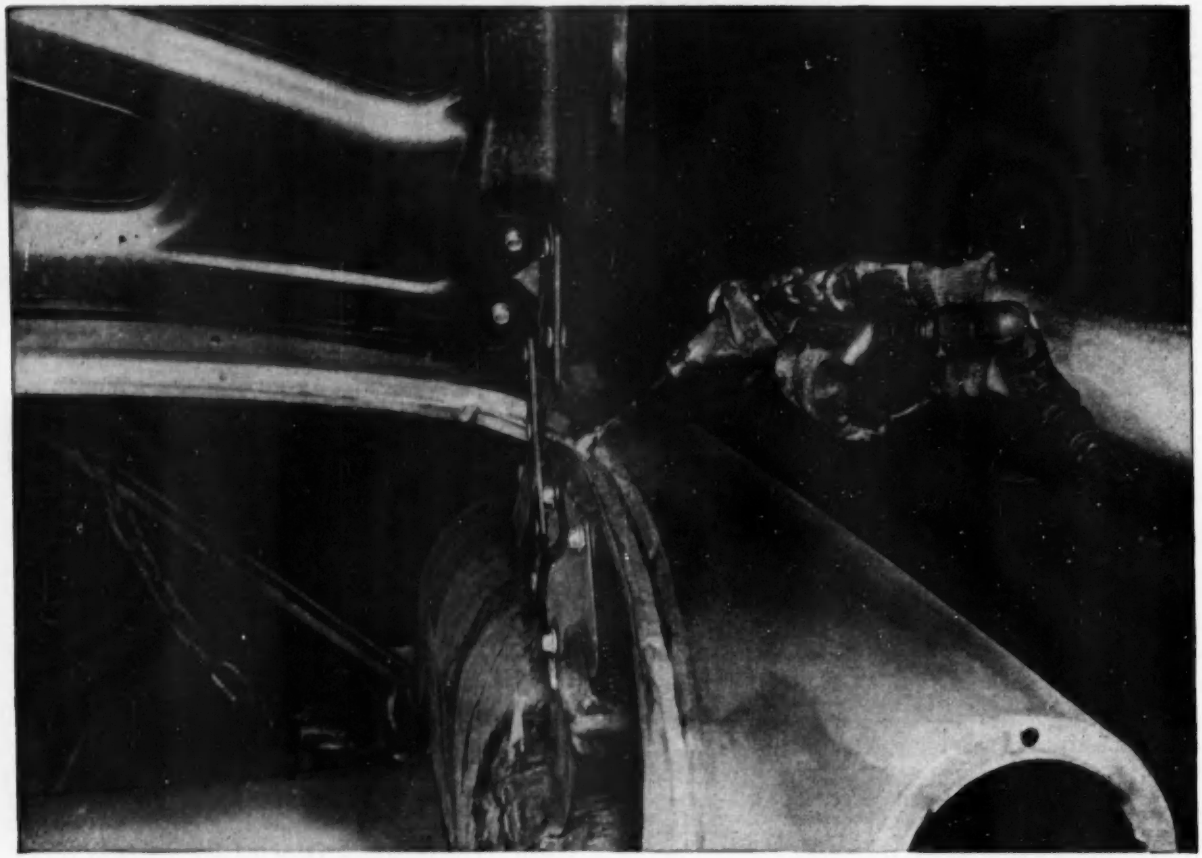
Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Company does not manufacture this plastic sealant. We make the Geon paste resin only.

WEATHER-PROOFED FOR THE LIFE OF THE CAR—with Geon!

CARS have vital spots where a dependable weather-sealant is a "must". And that's where Geon paste resin does a great protective job!

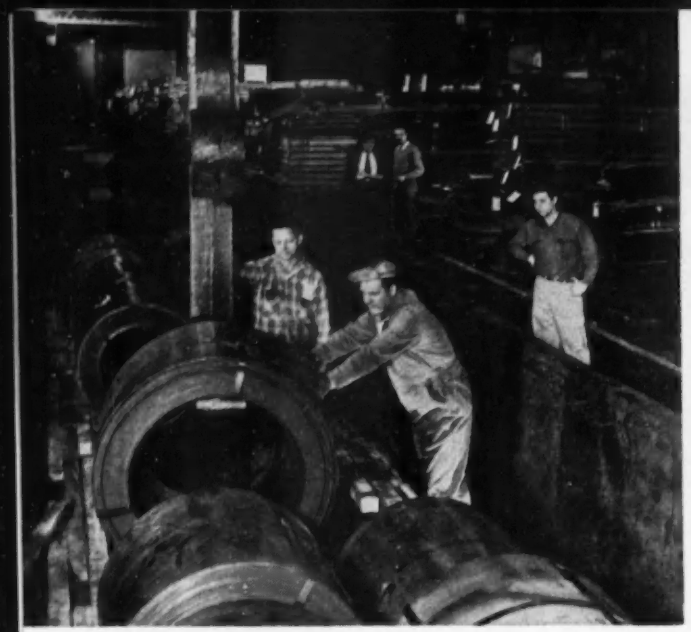
A plastic compound, made from this resin, is applied with air guns as cars move along the production line. Operators shoot the liquid-like vinyl plastic into the drip-guard rail around the car top, around the windshield frame, and along the trunk where rain, snow or dirt might leak past spot-weld seams into the car.

The easy-flowing plastic compound adheres tightly to the bare metal body. After the car is painted and baked, the sealant is completely fused and will not break off or crack during the life of the car.

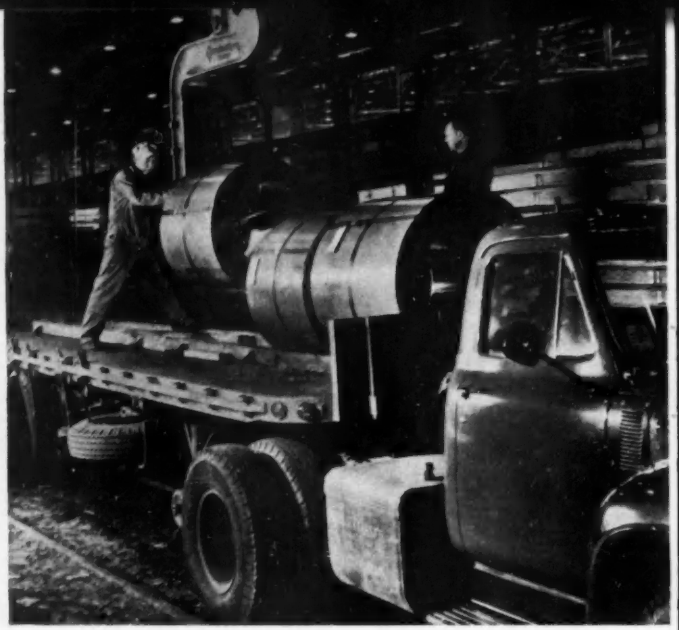
This use for Geon paste resin may point out ways to help you improve or develop more saleable products. It can be used in many coating, casting, molding or dipping operations—resists oil, greases and many chemicals. Upholstery, floor mats, trunk linings and electrical parts are only a few products made from Geon. For technical information, please write Dept. GR-2, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors



Whether you specify shipment by rail . . .



by truck . . .

Pittsburgh Steel's Goal: Making Delivery Meet Your Production Requirements for Hot

Making high quality steel sheet to exacting specifications on special order for many customers, each manufacturing different products, is a complicated job. It takes plenty of headwork to start each order with selected raw materials and deliver the finished sheet to the customer's plant when and how he wants it delivered.

Last summer Pittsburgh Steel Company opened a brand new hot rolled sheet mill at Allenport, Pa., on the Monongahela River near Pittsburgh. Right now, second quarter orders are being booked for cold rolled sheets from the company's new cold mill being readied at the same plant for first production in March. Problems of proving-in these new facilities make production scheduling and deliveries even more difficult.

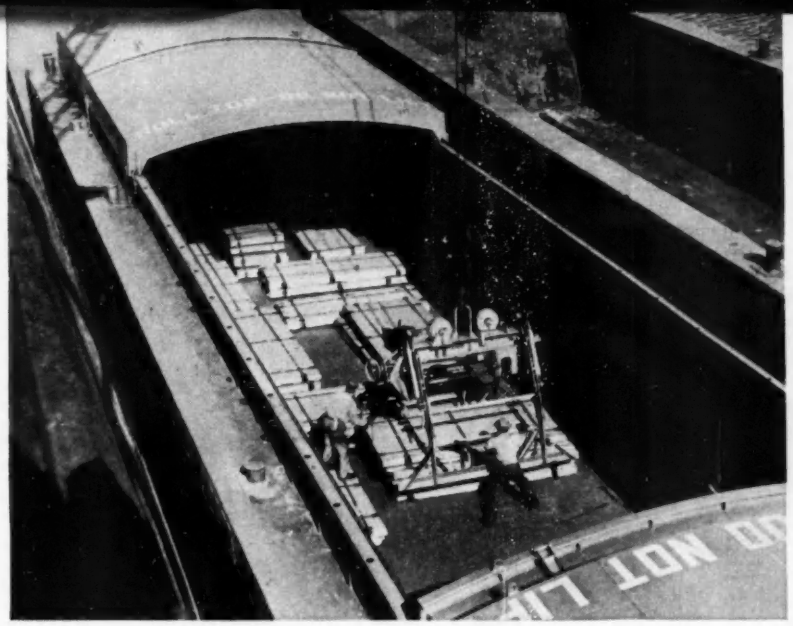
Yet the schedulers who are teaming up with production and traffic men to carry out this all-important assignment have a lot in their favor.

Pittsburgh Steel is a tightly knit, integrated producer. The close prox-

Incoming Orders from district offices for sheet steel are scheduled by George McLaughlin.

Central Control order scheduling chief, Dan Neuman (center) works out a "toughie" with "Ban" Roberts (right), chief sheet scheduler and his assistant Cecil Carroll (left).

Production Scheduling at both Monessen and Allenport comes under "Don" Shaughnessy.



or by barge, here's . . .

Transportation of the finished product is directed by Larry Weber (left) assistant to general traffic manager, George Dittmar (center) and "Ed" Siemon (right) of traffic department.

Schedules and Cold Rolled Sheets

imity of its plants and central sales control contribute to ease and speed in handling orders. Large enough to produce big tonnages, it is still small enough to have great flexibility.

• **Here's what this means to you**— From the time you place your order with Pittsburgh Steel, until it is delivered to your plant, your order is handled on a more personal basis. Throughout the company—from sales through the scheduling and production departments to traffic—your order gets more individual attention.

Today with steel plentiful and the emphasis on quality and service at the lowest possible price, customers must have accurate information on steel deliveries. They don't want steel coming in ahead of time because it lies around unused, costs extra money. And they don't want it to arrive late because that throws production schedules off and costs still more money.

Pittsburgh Steel men understand and appreciate these problems. Once your order is placed, they go to work conscientiously to fill your requirements. They don't always do the job perfectly. Just as with other producers, errors occur. But through the experience gained during the proving-in period for the hot rolled sheet mill, progress is being made and errors are occurring less frequently.

Above all else, this is the goal: To give you the finest quality hot and cold rolled sheet and strip, and the most dependable service that it is possible to produce with some of the industry's most modern rolling equipment. From the salesman who works directly with you to the last man in the shipping department, Pittsburgh Steel has teamed up to accomplish this goal.

Next time you need flat rolled steel, why not talk to a man from Pittsburgh Steel?

Shipping Steel Sheets from the mill at Allenport is the responsibility of "Ed" Fisher.

"Everything New But The Name"

Pittsburgh Steel Company

Grant Building • Pittsburgh 30, Pa.

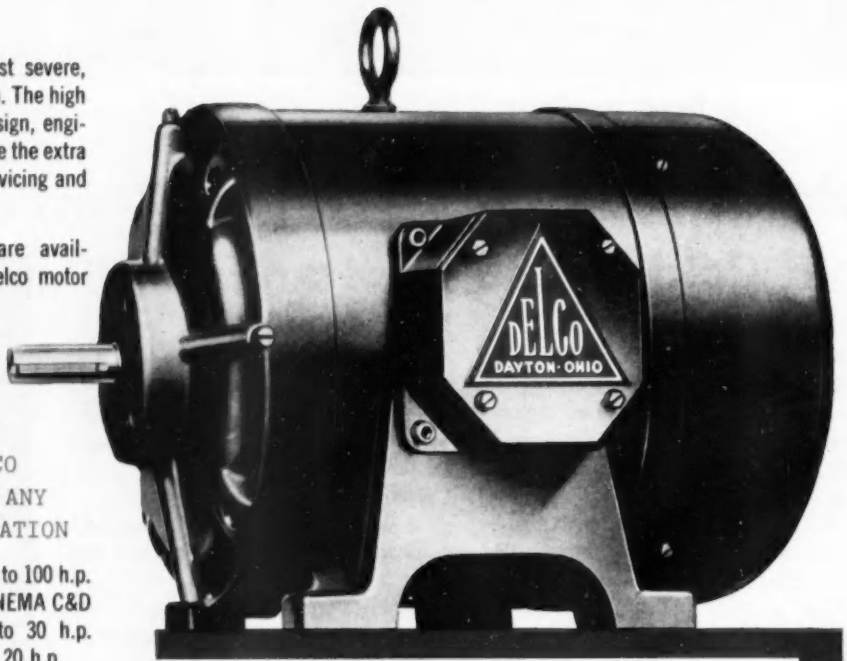
Sales Offices in Principal Cities Throughout the Country

To keep going longer... replace with

Delco Motors

When conditions are the most severe, Delco motors prove their worth. The high standards that guide their design, engineering and construction insure the extra endurance that minimizes servicing and down-time.

Delco replacement motors are available fast, from your local Delco motor distributor. Call him.



THERE'S A DELCO
FOR PRACTICALLY ANY
INDUSTRIAL APPLICATION

Open and enclosed motors up to 100 h.p. for standard foot mountings. NEMA C&D flange-mounted motors up to 30 h.p. Explosion-proof motors up to 20 h.p.

DELCO
DAYTON OHIO

DELCO PRODUCTS

Division of General Motors Corporation, Dayton, Ohio

A GENERAL MOTORS PRODUCT — A UNITED MOTORS LINE

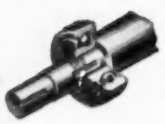
DISTRIBUTED BY WHOLESALERS EVERYWHERE

THESE FEATURES KEEP DELCO MOTORS GOING LONGER

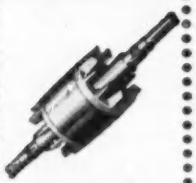
Water-Tight Conduit Box. Protects against moisture.

Positive Lubrication. Lengthens bearing life.

Delcote Insulation. Permanently flexible, moisture-proof, wear resistant.



Positioned Bearings. Maintain shaft alignment.



Dynamically Balanced Rotor and Shaft Assembly. Reduces vibration.

Corrosive-Resistant Cast Iron Frame. More solid, more rugged.

SALES OFFICES: Atlanta • Chicago • Cincinnati • Cleveland • Dallas • Detroit • Hartford • Philadelphia • St. Louis • San Francisco

Effects of Elements Used in Alloy Steels

This is the second of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

To simplify a rather complex subject, let's outline some of the individual effects of four leading alloying elements used in alloy steels:

NICKEL—One of the fundamental alloying elements, nickel provides such properties as deep hardening, improved toughness at low temperatures, low distortion in quenching certain types of tool steels, good resistance to corrosion when used in conjunction with chromium in stainless grades, and ready response to economical methods of heat-treating.

CHROMIUM—This element is used extensively to increase the corrosion-resistance of steel. It also improves the surface resistance to abrasion and wear. It exerts a toughening effect and increases the hardenability.

MOLYBDENUM—This element exerts a strong effect on the hardenability and toughness of steel. It greatly increases strength at high temperatures as well as the creep-strength of steel.

VANADIUM—An element used to refine the grain and enhance the mechanical properties of steel.

A combination of two or more of the above alloying elements usually imparts some of the characteristic properties of each. For example, chromium-nickel grades of steel develop good hardening properties with excellent ductility. And chromium-molybdenum steels develop excellent hardenability with satisfactory ductility and a certain amount of heat-resistance. In other words, the total effect of a combination of alloying elements is usually greater than the sum of their individual effects. This interrelation must be taken into account whenever a change in a specified analysis is evaluated.

Bethlehem metallurgists can be of considerable help to you in selecting the proper alloy steel for any use. These men will gladly give unbiased advice on alloy steel analysis, heat-treatment, machinability, and expected results. Feel free to call upon them at any time.

And please remember, too, that Bethlehem manufactures all AISI standard alloy steels, as well as special-analysis steels and the full range of carbon grades. You can rely upon their quality, always.

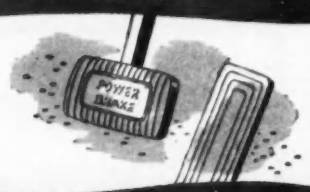
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM ALLOY STEELS

BETHLEHEM STEEL

Bendix *the only performance* PROVEN *Low Pedal Power Brake*



Now a PROVEN sales producer for leading car manufacturers

Specified by More Car Manufacturers Than Any Other Make

The car buying public has been quick to recognize that the Bendix* Low Pedal Power Brake is not only a most desirable new car feature, but that its effortless, quick and positive braking actually is a revolutionary advancement in motor car control. Thus, the car manufacturer offering his customers this advanced feature has a decided advantage over competition.

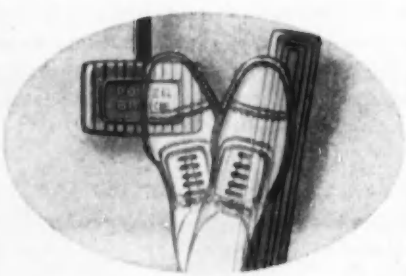
That this is an established fact and not a theory is unmistakably proven by the ever increasing percent of car buyers specifying the Bendix Low Pedal Power Brake on cars offering it as optional equipment . . . tangible evidence that the Bendix Low Pedal Power Brake is one of the most popular devices offered the public in years.

This greatest improvement in braking since four wheel brakes is unique in many ways. It is, for example, the only low pedal power brake that has met the test of millions of miles under all operating conditions. In fact, Bendix Low Pedal Power Brake is specified by more manufacturers than any other make. Remember, too, this new low pedal power brake is the product of Bendix—world's largest producer of power brakes and leader in braking developments since the earliest days of the industry.

For any car manufacturer interested in adding a big plus to his sales story, the Bendix Low Pedal Power Brake is the answer.

*REG. U.S. PAT. OFF.

NOW *Stopping* IS AS EASY AS *accelerating*



It is no longer necessary to lift the foot and exert leg power pressure to bring your car to a stop. With the Bendix Low Pedal Power Brake on about the same level as the accelerator, an easy ankle movement, much like working the accelerator, is all the physical effort required for braking. And by merely pivoting the foot on the heel, shifts from "go" to "stop" controls are made in far less time.

Result! **MORE DRIVING COMFORT, LESS FATIGUE AND GREATER SAFETY**

Bendix Products Division

BENDIX PRODUCTS DIVISION SOUTH BEND

Bendix
AVIATION CORPORATION

MOST TRUSTED NAME IN BRAKING

Export Sales: Bendix International Division, 205 East 42nd St., New York 17, N. Y. • Canadian Sales: Bendix-Eclipse of Canada, Ltd., Windsor, Ontario, Canada

AUTOMOTIVE INDUSTRIES

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High Spots of This Issue

★ **Machines and Methods at Ford's Dearborn Engine Plant**

Operations on the cylinder block and heads for the new Ford overhead-valve V-8 engine are covered in this initial article of a series on the Dearborn facility. The highly automated machine tools are treated in some detail. Page 26.

★ **Current Developments Discussed at Plastics Meeting**

The ever-growing tidal wave of interest in reinforced plastics broke over Chicago recently at the Ninth Annual Meeting of the Reinforced Plastics Div. of SPI. Reviewed here are the ideas, exhibits, and papers presented. Page 36.

★ **Timely Engineering Developments**

Since spatial limitations did not permit their use in a former report on the Detroit SAE Meeting (see AUTOMOTIVE INDUSTRIES, February 1, page 58), abstracts of some of the notable papers are printed in this issue. See Page 42.

★ **Laminated Plastic Tooling Cuts Lead Time**

Goodyear Aircraft has jumped on the plastics tooling bandwagon by using it for jigs, fixtures, and dies to make aircraft components. The author describes the unique process by which GAC manufactures these production aids. Page 46.

★ **Design and Production of Light Alloy Forgings**

The Air Force Heavy Press Program has stimulated a great deal of interest in the forging of large aluminum aircraft parts by this method. The problems which have evolved, their solutions, and techniques developed are discussed. Page 52.

★ **29 New Product Items**
And Other High Spots, Such As:

New engines for British Rover cars; jet engine blades trimmed by friction sawing; Berliet buses have frame of unique design; the sinking factory; two-stroke Diesels for British cars; filtering cutting oil at Auto-Lite plant; and Eaton automatic drive uses magnetic clutches.

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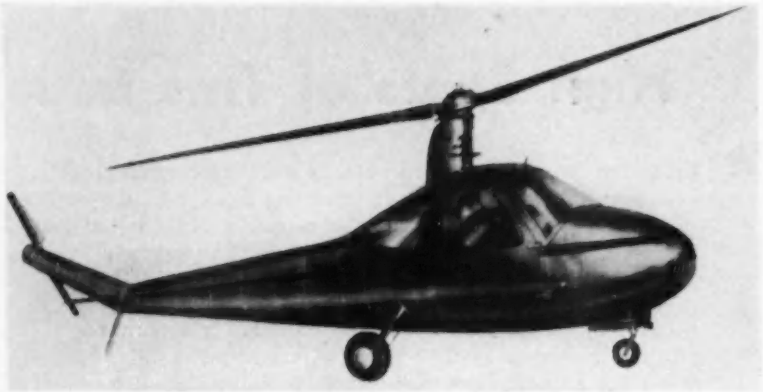
News of the AUTOMOTIVE



BUSINESS AND PLEASURE HELICOPTER

Glenview Metal Products Co. plans to market in the near future its two-passenger Flyride helicopter for both business and private flying. Featuring simplified single-stick control, it employs a two-blade semi-rigid type lifting rotor with a tail rotor for torque compensation and is powered by a Lycoming 140-hp engine. The plane has an empty weight of 1150 lb, length of 24.4 ft, height of 8.7 ft, maximum speed of 108 mph, service ceiling of 12 500 ft, and cruising range of 300 miles.

Packard Commences Modernization Program

Packard's move of its engine, automatic transmission, and axle operations to its new large plant at Utica, Mich., has several interesting implications. It indicates, among other things, that Packard will have its new V-8 engine ready for 1955 models and that the company is putting itself into a good position for more efficient production in line with its market potential, either as an individual operation or as part of a possible combination with one or more other automobile producers.

Utica Plant Use

The new plant is of the latest modern single-story construction and was built originally for production of jet engines. The contract was reduced last year, thus freeing space for other Packard operations. About one million of the 1.5 million sq ft of manufacturing area will be used by Packard for automotive operations. More will be made available when the jet engine job is terminated. It is estimated that about 1.25 million ft will be freed at the Detroit plant, which now comprises four million sq ft.

Other Plans

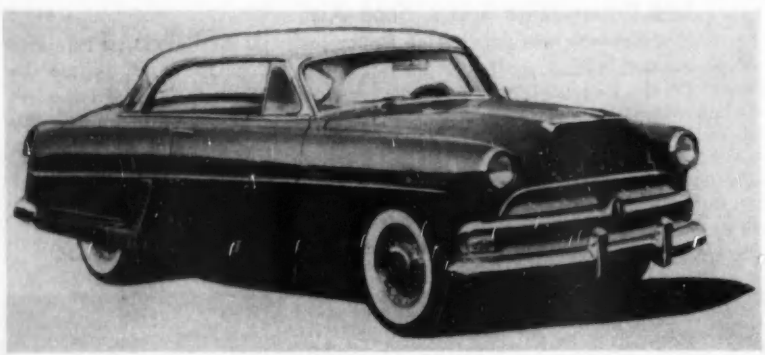
The move to Utica is the first of several steps in the company's modernization program, and more are expected soon. Packard emphasizes that it does not intend to abandon its Detroit operation "in the foreseeable future," but it is obvious that as much as possible of its operation will be moved to the more modern new plant.

There is a possibility that space freed in Detroit may be used for manufacture of bodies, since Packard eventually will have to find a different source in view of the purchase of Briggs by Chrysler. Packard at one time built its own bodies.

New Engine Due

Installation of completely new and modern tooling for a new engine is about 40 per cent completed at Utica and is scheduled to be finished by September. The automatic transmission and axle tooling also will be finished in time for 1955 model production.

Cost of the program was not announced, but it has been estimated at close to $50 million. Packard currently has a $20 million credit arrangement with 14 banks on which to draw, and it expects to undertake some long-term financing for parts of the modernization program still to come.



HARDTOP HUDSON

Priced almost $100 under the 1953 model, the 1954 Hudson Hollywood Hardtop is said to offer improved performance. Interiors are more luxurious, and exterior ornamentation is more lavish. The Hollywood comes in the Hornet and Super Wasp series.

Ford Suggestion Plan At New High in 1953

Ford Motor Co. reports a record $542,918 was paid to participants under its employee suggestion plan last year. This brought to $2,004,070 the total amount paid to employees since the program started in 1947.

Of the record 48,734 suggestions submitted in 1953, 12,428 were adopted for trial and 11,393 cash awards paid. A total of 173,743 suggestions has been processed, and 40,062 persons have won cash awards.

AND AVIATION INDUSTRIES

Oldsmobile Plans Large Forge Plant Expansion

A new battery of punch presses, a higher capacity coil steel blanking press, and additional die making equipment are among the major additions included in a scheduled expansion program at Oldsmobile's main and forge plants in Lansing, Mich. The project, which will be confined largely to the division's forge plant, is part of General Motors' recently announced billion-dollar program (see AUTOMOTIVE INDUSTRIES, Feb. 1, p. 55 and Feb. 15, p. 19).

The entire program at Oldsmobile, which is expected to be completed this year, also includes new bumper plating facilities at the Saginaw St. plant. Included in the expansion at the main plant are additional new equipment in the engine, pressed metal, and axle plants and the shifting of presses and handling equipment into Building 37, originally constructed for steel storage and engineering shops.

In addition to the die making equipment and forging presses at the forge plant, new trim presses, upsetters, induction heating furnaces, draw furnaces, and heat treating furnaces also are being added. The interior and exterior of the customer "driveway" building at Logan and Olds Ave. will also be expanded and modernized.

Chrysler Sales at Peak But Earnings Decline

Despite record sales of more than $3.84 billion, Chrysler Corp's net income for 1953 dropped five per cent from the previous year to $74.78 million, according to the company's annual report to stockholders. Total sales for the year represented an increase of 28.7 per cent over the previous year's $2.6 billion.

The report shows net earnings as per cent of sales down 26.4 per cent from 3.03 in 1952 to 2.23 in 1953. The report further notes that military products accounted for 20 per cent of the total business in 1953 and amounted to $660 million.

According to the report, sales of Chrysler passenger cars were the highest in the company's history in totaling 1,236,719, compared with 956,089 in 1952. Sales of all Chrysler-built vehicles in 1953, including Dodge trucks, amounted to 1,344,583, as against 1,114,228 the preceding year, but second to the 1,395,833 in 1951.

To meet the demand of the growing Canadian car and truck market, Chrysler Corp. of Canada now has underway a program to expand its daily production capacity. Included in the new facilities will be substantial extensions to its present passenger car and truck producing plants, a new motor plant, and three new spare parts and accessories depots.

Investment in properties, including the acquisition of the Briggs body interests, exceeded the depreciation and amortization charges for the year, the report notes. The net increase in property values was more than the amount of earnings retained and was primarily responsible for the decrease in net current assets, which declined from $223.8 to $199.4 million.

FORD THUNDERBIRD BOWS

Although known as the "Fairlane" during its development stage, the sleek new Ford model above has officially been dubbed "Thunderbird." Scheduled to be placed in production next fall, the car has an all-steel body and is powered by a new 160-hp, Y-block, V-8 engine. While it is equipped with a convertible cloth top, a special composition hardtop can be purchased. Standing 51.5 in. high, it is 175.5 in long with a 102-in. wheelbase. Curb weight is 2837 lb. and road clearance is 5.5 in.

EXPERIMENTAL TWO-WAY PLANE

The XV-1 Convertiplane, developed jointly by the Air Force and McDonnell Aircraft Corp., uses a pressure jet unit on each rotor blade unit for vertical flight and a reciprocating pusher-type engine for forward flight. The plane is about 30 ft long, 10 ft high, and has a wing span of 26 ft. A commercial model is under development.

News of the AUTOMOTIVE

Mercedes-Benz Model 300 SL with fuel injection system is said to develop an output of 240 bhp and to accelerate from 15 mph to 170 mph in fourth gear.

1953 NEW TRUCK REGISTRATIONS*

Arranged by Makes in Descending Order According to the 1953 Twelve Months' Totals

MAKE	December 1953	November 1953	December 1952	TWELVE MONTHS Units 1953	Units 1952	Per Cent of Total 1953	Per Cent of Total 1952
Chevrolet	21,393	22,393	25,675	327,960	272,249	35.24	33.51
Ford	25,013	27,753	16,990	266,027	179,523	28.59	22.10
International	6,294	8,459	8,295	95,404	92,788	10.25	11.42
Dodge	6,159	5,332	7,884	82,345	102,129	8.85	12.88
G. M. C.	4,971	5,400	6,514	82,296	79,612	8.85	9.80
Studebaker	968	1,209	2,194	22,473	28,985	2.42	3.57
White	816	1,020	652	12,261	11,108	1.32	1.37
Willys Jeep	782	700	967	9,247	8,594	.99	1.06
Willys Truck	627	648	1,116	8,465	11,782	.91	1.45
Mack	456	465	517	6,890	7,138	.74	.88
Reo	235	238	253	3,496	3,393	.38	.42
Diamond T	240	232	227	3,366	3,420	.37	.42
Divco	211	230	166	2,569	2,752	.28	.34
Brockway	152	160	177	2,060	1,752	.22	.22
Autocar	104	96	140	1,713	1,595	.18	.20
Federal	91	64	81	966	841	.11	.10
Kenworth	27	40	40	747	705	.08	.09
Pontiac	29	28	41	468	541	.05	.07
F. W. D.	28	20	38	388	543	.04	.07
Peterbilt	8	8	10	332	236	.04	.03
Misc. Domestic	43	80	154	516	2,141	.06	.26
Misc. Foreign	14	21	24	276	292	.03	.04
Total—All Makes	68,659	72,896	69,949	930,312	812,099	100.00	100.00

* Based on data from R. L. Polk & Co.

IMMS Show Enthusiasm for Unusual Vehicles

The same current wave of interest in unusual cars of all types which made itself felt at the recent World Motor Sports Show (see AUTOMOTIVE INDUSTRIES, Feb. 15, p. 42) also swept over the International Motor Sports Show, held the second week of February in New York City. At the former show, 300 car sales totaling over $1-million were made, while a brisk business throughout the running of the latter produced a final sales volume running to similarly astronomical heights.

The 92 domestic and foreign models on display included types in every price range from a $1400 Volkswagen or Standard Cadet to the $25,000 Alfa-Romeo B.A.T., and in every size from the kit-assembled King Midget to the huge Rolls-Royce. Up and down every aisle were sports, family, luxury, utility, and personal cars representing six major countries (U. S., Great Britain, France, Italy, Germany, and Argentina).

Such a vast array of vehicles was on display that it would be impossible to enumerate them all here. Furthermore, since the great percentage of them have been covered in previous articles in AUTOMOTIVE INDUSTRIES, it seems in order here just to mention briefly a few with distinctive features.

Of prime interest in the German section was the new Mercedes-Benz 300 SL with fuel injection system (see cut). In the French exhibit area was an American adaptation of a Renault racing car with a plastic body. The four-cyl, rear-engine car, mounted on a Renault 750 chassis, will be built in the U. S. by PlastiCar, Inc., in a plant at Doylestown, Pa. Other examples of plastic bodies were to be found in the two-seat, unassembled Vega sports car and the Packard Panther (see AUTOMOTIVE INDUSTRIES, Feb. 15, p. 21).

Mexican Vehicle Taxes

The Mexican Government has revised its tax laws to permit taxation of vehicles propelled by Diesel engines or those adapted for LP.G.

AND AVIATION INDUSTRIES

Chrysler Decentralizing To Divisional Basis

Chrysler Corp. is starting a decentralization program which will make its various divisions more competitive and put each one on an individual profit basis. Confirmation of the long-reported decentralization trend came in the company's annual report, which stated that "a divisionalized structure of semi-autonomous profit centers will provide the management with a better framework for development of the corporation's growth in the years ahead."

Sketchy information available about the program indicates that the changes will be more transitional than abrupt and will be extended over a considerable period of time. The first change will be in the area of accounting procedures to give divisional management a much closer control over costs. Heretofore, cost data have been handled on a central office level and has been rather remote from individual divisional management so far as any actual control is concerned.

Under the new procedure, cost accounting will be centered at the division and the management given considerably more freedom on cost decisions. This does not indicate, however, that individual division purchasing departments are contemplated, at least for the present.

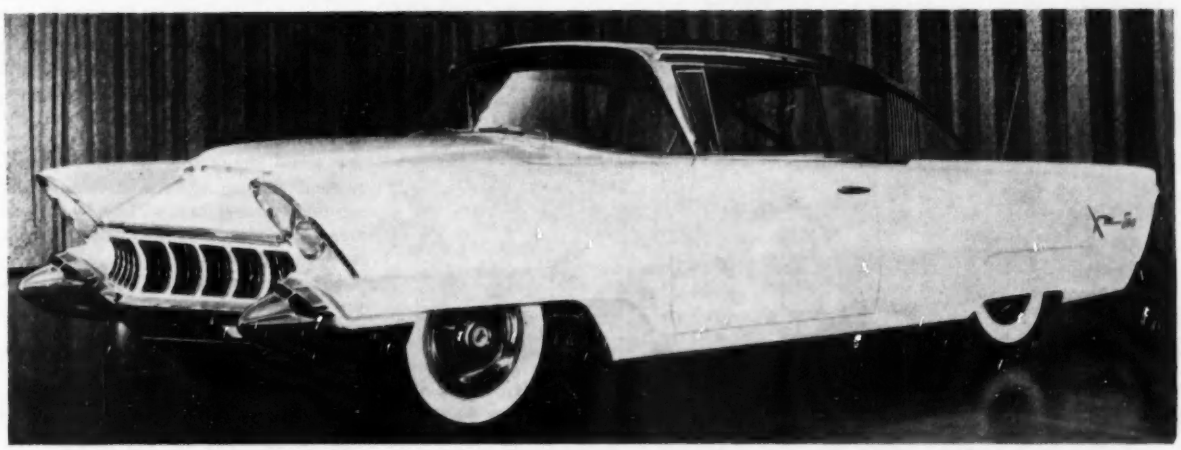
The decentralization program stems from a rather exhaustive study of the corporation's organizational structure started many months ago and still continuing. No details are available yet as to what other areas of the business will be decentralized. One company source says that, when the program is completed, the company will be substantially decentralized in relation to its present structure. It probably will not, however, go back as far as General Motors has in that respect.

1953 NEW PASSENGER CAR REGISTRATIONS*

Arranged by Makes in Descending Order According to the 1953 Twelve Months' Totals

MAKE	December 1953	November 1953	December 1952	TWELVE MONTHS Units 1953	Units 1952	Per Cent of Total 1953	Per Cent of Total 1952
Chevrolet	83,020	105,760	76,084	1,342,480	852,542	23.39	20.49
Ford	100,813	108,697	80,172	1,116,267	732,481	19.45	17.60
Plymouth	47,221	47,271	82,064	600,447	433,134	10.46	10.42
Buick	26,739	35,141	23,991	454,320	310,806	7.92	7.47
Pontiac	25,061	28,378	22,769	385,692	266,351	6.72	6.41
Oldsmobile	21,223	18,329	17,255	305,593	218,189	5.32	5.28
Dodge	18,075	19,678	23,529	288,812	246,464	5.03	5.93
Mercury	27,932	29,009	22,573	287,717	185,883	5.01	4.47
Studebaker	10,509	10,219	15,803	161,257	157,902	2.81	3.80
Chrysler	12,042	10,965	11,386	153,756	113,392	2.68	2.73
Nash	7,756	6,272	12,801	137,507	142,520	2.40	3.43
De Soto	9,658	8,962	10,151	122,342	91,677	2.13	2.20
Cadillac	9,433	6,781	4,777	98,612	87,906	1.72	2.11
Packard	3,174	3,158	6,149	71,079	66,346	1.24	1.60
Hudson	4,177	4,267	5,683	66,797	78,509	1.16	1.89
Willys	1,957	2,109	3,858	42,433	41,016	.74	.99
Lincoln	2,513	1,450	2,890	39,169	29,110	.68	.70
Kaiser	730	772	3,506	22,825	41,022	.40	.99
Henry J	246	303	1,792	10,710	28,716	.19	.69
MG (British)	312	276	573	6,606	7,449	.12	.18
Hillman (British)	303	269	377	4,506	4,782	.08	.11
Jaguar (British)	220	276	366	3,914	3,349	.07	.08
Ford (British)	188	203	352	3,644	3,854	.06	.09
Austin (British)	161	182	322	3,067	4,804	.05	.12
Allstate	2	13	90	675	1,566	.01	.04
Misc. Domestic	112	46	74	1,538	3,661	.03	.09
Misc. Foreign	560	535	519	7,204	5,061	.13	.12
Total—All Makes	413,937	450,311	399,906	5,738,969	4,158,394	100.00	100.00

* Based on data from R. L. Polk & Co.



EXPERIMENTAL STREAMLINED MERCURY SPORTSTER

The Mercury Monterey XM-800 four-passenger hardtop coupe, which will go into production later if public demand warrants, was first exhibited at the Detroit Automobile Show. While the prototype has a Fibreglas body, production units would probably be of steel. Only 55.6 in. high, it has a wheelbase of 119 in., is 207.4 in. long, and 78.8 in. wide. A new V-8 engine would power it.

News of the AUTOMOTIVE AND AVIATION INDUSTRIES

Car Sales Picture Remains Hazy in Market Adjustment Period

At no time since before World War II has there been such complete uncertainty over the market for new cars as now exists. A rising chorus of lamentation from organized automobile dealer groups, if taken at face value, would indicate that the market is, at worst, saturated and, at best, at a level below current production.

Normalcy Returns

What a great many dealers and perhaps some manufacturers have forgotten is that the late months of 1953 and the early months of this year have seen a return to a pre-war seasonal pattern of demand that did not exist from the end of World War II until late last year. Admittedly, sales of new cars have eased off during December, January, and February, but that always was true in a normal year.

The manufacturers have taken note of the build-up in dealer inventories of new cars and have reduced production accordingly. The big question appears to be whether they have cut it enough.

Age-Old Problem

One of the perennial problems of the automobile industry has been for the manufacturers to provide dealers with just the right amount of automobiles, so that company, dealer, and the buying public receive equitable treatment. Too many cars have resulted in excessive dealer inventories and price cutting, and greatly reduced profit margins have resulted.

In periods of scarcity, dealers reaped a bonanza by retaining full discounts, making money on trade-ins, and loading unwanted accessories onto unwilling customers. These conditions are unheard of in any normal market.

Outlook Hopeful

It appears that the industry currently is again going through the normal shakedown procedure of adjustment to the market. This means that dealer stocks first grow heavy, and the manufacturers then adjust production schedules downward. The foregoing already has been in effect for some time, and, if the expected normal spring upturn develops, the manufacturers then will be in a position to gage production pretty much in line with demand.

The automobile industry always has prospered under competitive conditions, and there is little to suggest that the same will not be true this year. While some companies will not do as well as others, there is nothing to indicate a great reduction in the market potential for the industry as a whole.

Continued on Page 20

ANOTHER MOTORAMA TRIO

Three more experimental plastic-body cars exhibited at the GM Motorama (see Automotive Industries, Feb. 1, p. 56 and Feb. 15, p. 20) are: Top—Chevrolet Corvette hardtop has a removable plastic roof which is fastened to the windshield in two places and to the top compartment lid in two. Center—Cadillac La Espada convertible is 200.6 in. long, 79.9 in. wide, and 51. 7 in. high; powered by a Cadillac 230-hp engine, it has a wheelbase of 115 in. Bottom—Pontiac Strato Streak sports car is a four-passenger hardtop that is 214.3 in. long, 74.5 in. wide, and 54.5 in. high; it is powered by a high-performance Pontiac straight-eight engine.

Free INFORMATION SERVICE

Postage-Free Postcards Are Provided Here for Your Convenience to Obtain FREE LITERATURE and Additional Information on NEW PRODUCTION AND PLANT EQUIPMENT, AND NEW PRODUCTS Described in This Issue of AUTOMOTIVE INDUSTRIES. Please Circle Code Numbers of Items In Which You Are Interested, Print Name, etc., and Mail Promptly for Quicker Service.

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FREE LITERATURE

Fluid Cold Starter 1

Details of the Ampco-Sinclair engine starter displayed recently at the SAE annual meeting are now available. *Automotive & Marine Products Corp.*

Accelerometers 2

Glennite accelerometers A104 and A104-2, general purpose pickups for small space, now are available and described on a one-page bulletin. *Gulton Mfg. Corp.*

Tool Accessories 3

Knobs, wheels, jig and fixture components, and master shank holders are described in 12-page catalog 52. *G. F. Bub & Son.*

E-P Switches 4

Explosion-proof switches are described on data sheet 81. *Micro Div. of Minneapolis-Honeywell Regulator Co.*

Double-Ender 5

A new two-page catalog sheet describing a line of horizontal double end machines that can bore, chamfer, burr, mill, center, flare or spin tubular and solid metal parts at production rates up to 6000 pieces per hour is now available from *Walter P. Hill, Inc.*

Casting Story 6

A three-dimension slide film series in color showing precision investment castings being made from frozen mercury patterns is announced. The film is designed to aid engineers and executives in planning their products for mercasting. *Alloy Precision Castings Co.*

Molding Press 7

The redesigned model 731 semi-automatic compression molding press of 150-ton capacity is described in a new bulletin, No. 516, just issued. The toggle press is especially suited for molding parts requiring delicate insert work, parts with thick and thin sections, or parts with pins and projections. *F. J. Stokes Machine Co.*

Tapping Screws 8

An eight-page booklet on "Tapping Screws" describes in detail seven different types of screws which form their own threads as they enter various types of materials. A selection chart describes what screws are recommended for sheet metal, sheet stainless steel, structural steel, ferrous and non-ferrous castings, ferrous and non-ferrous forgings, thermosetting and therm-plastic plastics, plastics, plywood and compositions like asbestos. *Townsend Co.*

(Please turn page)

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Spray Nozzle 9

In the 48-page catalog No. 24, thousands of standard and special industrial spray nozzles are illustrated and described. For each nozzle, complete data are listed covering capacity and spray angle. Dimensional specifications for all standard nozzles are also given. *Spraying Systems Co.*

Surface Grinders 10

A line of six in. by 18 in. reciprocating table surface grinders are described in bulletin 618, showing operating features, specifications and dimensions. These grinders feature finger-tip level controls, cartridge type motorized spindle and hand-scraped ways. Accessories are pictured and described. *Reid Brothers Co., Inc.*

Presses 11

Representative hydraulic presses and equipment manufactured by this firm for the metalworking, rubber, plastics and woodworking industries are illustrated in a brochure. It contains basic hydraulic press specifications in addition to representative high pressure hydraulic valves, accumulators and shock alleviators. *R. D. Wood Co.*

USE THIS POSTCARD

Drives 12

Automatic Production Control, bulletin G-537, covers the complete line of automatic controls available on variable speed drives. This 24-page booklet describes not only the controls available but the means of solving problems involving the control of tension, the control of acceleration and deceleration, velocity and peripheral speed, synchronization of one or more machines, and the maintaining of uniform temperature, pressure, liquid level, flow, etc. *Reeves Pulley Co.*

Bending Process 13

This new catalog describes the process of tangent bending, a forming process used in metal cabinet making with a technique all its own. Containing 28 pages in two colors, it shows many domestic and industrial applications. *The Cyril Bath Co.*

Plastic Tooling 14

"Laminate Plastic Anchor Busing Drill Templates," giving "how to make" data, represents the latest technical information for shop use, as practiced at Douglas Aircraft Co. *Hi-Shear Rivet Tool Co.*

Instrument Line 15

The first complete presentation of its line of precision instruments is now available in a fully illustrated 16-page general catalog. *Chicago Dial Indicator Co.*

Valves 16

A 48-page catalog on Marotta Valves, No. 200, used for d-c electrical or pressure control of a variety of fluids, has been announced by the *Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co.*

Amplidyne Systems 17

Amplidyne systems—how they operate, and where they can be used—are described in a new two-color, 24-page booklet GEA-4053 announced as available from the *General Electric Co.*

Strain Gage 18

The improved Whittemore strain gage, a hand type, dial micrometer instrument for two-in. and 10-in. gage lengths, is described in an illustrated two-page Bulletin 4207 by *Baldwin-Lima-Hamilton Corp.*

Mounting Pads 19

An eight-page booklet describes the use of Unisorb mounting pads. *The Felters Co., Unisorb Dept.*

Collets 20

Collet and Chuck Bulletin, No. 100E, has just been published by *Rivett Lathe & Grinder, Inc.*

Tubing 21

"Flexineering"—the application of flexible tubing for air, oil, steam, gases, and volatiles—is explained in an eight-page illustrated data book just published by *Pennsylvania Flexible Metallic Tubing Co.*

AI Index 22, 23

Check 22 on postcard for an index to Vol. 109 (July 1 to Dec. 15, 1953) of AUTOMOTIVE INDUSTRIES. A limited number of copies of the index to Vol. 108 (Jan. 1 to June 15) are available. Check 23 on postcard if you want this index also. *Automotive Industries.*

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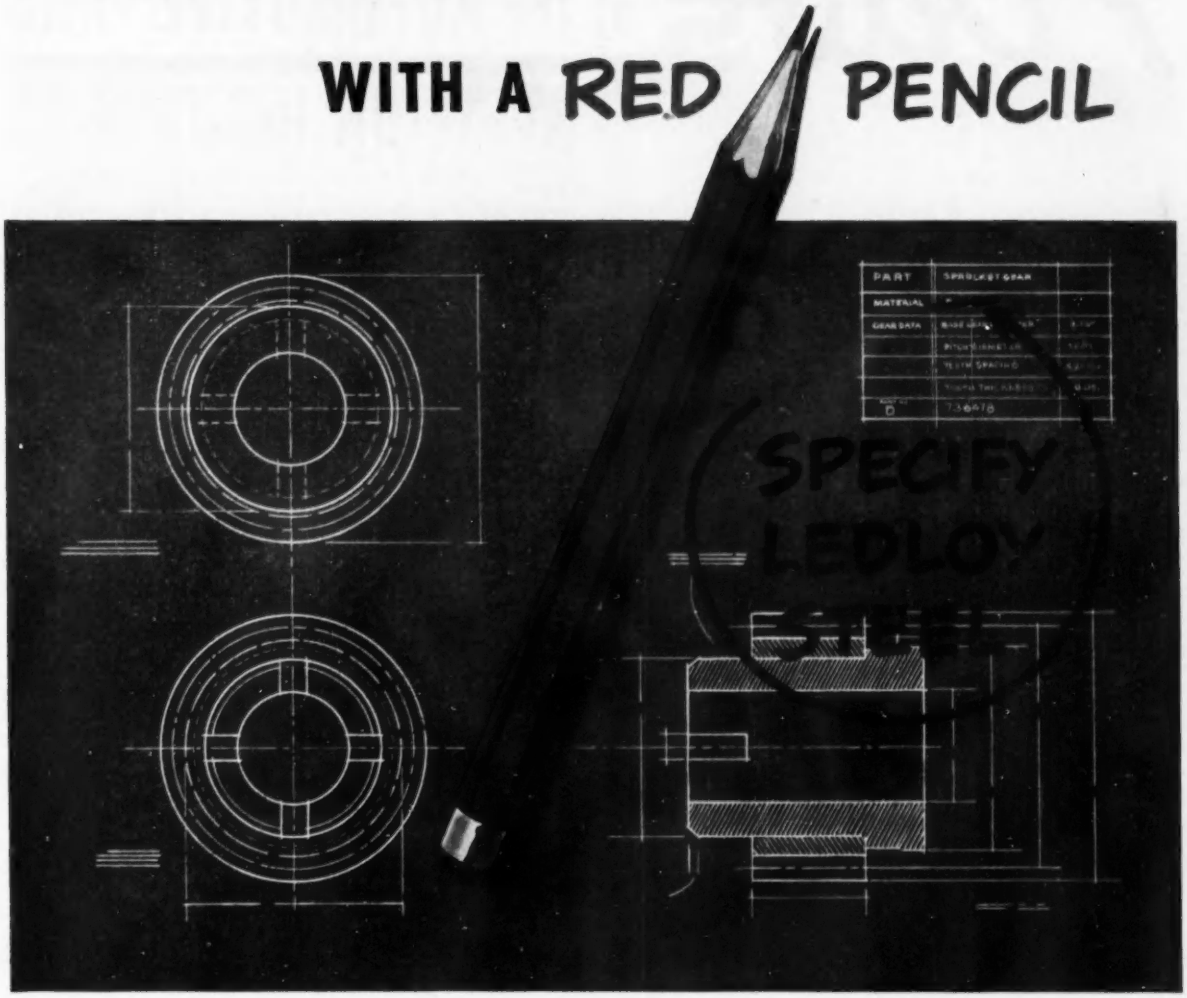

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News of the AUTOMOTIVE AND AVIATION INDUSTRIES

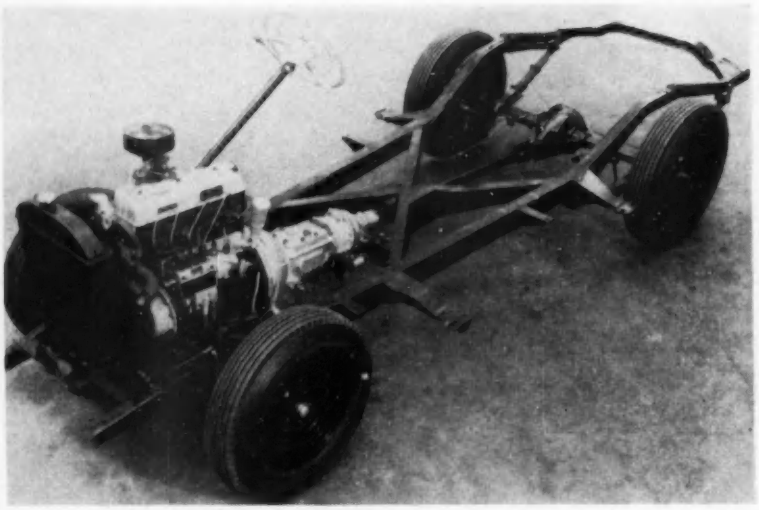
Continued from Page 16

Studebaker Gears Output To Dealers' Potential

Studebaker is going to put the welfare of its dealer body ahead of all other considerations in this "shakeout" year of 1954, according to C. K. Whittaker, new vice-president in charge of sales. He told a press meeting in Detroit that the company's first objective this year is to come through with a strong dealer body and that production is to be based on what dealers can sell profitably. He indicated, however, that the company will keep pressure on its retail outlets to keep cars moving.

Mr. Whittaker's comments that he did not know whether or not Studebaker would make much money this year and that he hoped dealers would sell cars in sufficient volume to enable the company to break even points up the difficult year expected by the independents. He added that the entire industry is undergoing a reorganization of its thinking and that conditions will stabilize by next year.

Studebaker is aiming at four per cent of the market this year, compared with about 2.8 per cent in 1953, when tooling problems and strikes curtailed production during the months of strongest demand for cars. The four per cent goal is a drop from the five per cent announced last fall when 1954 models were introduced.



STANDARD FOUR-CYL DIESEL

Standard Motor Co., Ltd., has produced a four-cyl Diesel engine which will be available in Standard Vanguard models. The engine, a development of the one which has been used on Ferguson tractors, has a compression ratio of 17:1 and develops 40 bhp at 3000 rpm. A feature of the engine is the use of the Freeman-Sanders combustion chamber. Fuel is injected by a C.A.V. atomizer into a spherical combustion chamber in the cylinder head, which opens directly above a crescent-shaped air cell machined in the cylinder block. The engine now weighs 539 lb.

1953 RETAIL CAR SALES BY PRICE GROUPS* NUMBER OF CARS

	December				Twelve Months			
	1953		1952		1953		1952	
Price Group	Units†	% of Total	Units†	% of Total	Units†	% of Total	Units†	% of Total
Under $2,000	239,511	58.12	223,580	56.29	3,217,295	56.36	2,162,576	52.68
$2,001 to $2,500	118,488	28.76	111,544	28.08	1,605,228	28.12	1,223,341	29.64
$2,501 to $3,500	34,460	8.36	47,723	12.01	664,881	11.65	540,344	13.09
Over $3,500	19,641	4.77	14,397	3.62	221,147	3.87	181,411	4.39
Total	412,070	100.00	397,244	100.00	5,708,551	100.00	4,127,672	100.00

DOLLAR VOLUME OF SALES*

	December				Twelve Months			
	1953		1952		1953		1952	
Price Group	Dollars	% of Total	Dollars	% of Total	Dollars	% of Total	Dollars	% of Total
Under $2,000	$429,589,722	49.69	$368,086,519	48.10	$5,750,461,860	47.96	$3,852,309,241	44.38
$2,001 to $2,500	269,453,350	31.16	248,879,815	30.06	3,590,122,917	29.94	2,715,674,815	31.23
$2,501 to $3,500	93,317,810	10.79	127,435,902	15.39	1,823,301,316	15.21	1,454,590,134	16.73
Over $3,500	72,305,944	8.36	53,431,004	6.45	826,421,746	6.89	666,332,858	7.66
Total	$864,666,826	100.00	$827,833,240	100.00	$11,990,307,839	100.00	$8,694,906,948	100.00

*—Calculated on basis of new car registrations, as reported by R. L. Polk & Co., in conjunction with advertised delivered price at factory of four door sedan or equivalent model. Does not include transportation charges or extra equipment.
†—New registrations of American made cars only. Does not include imported foreign cars.

General Tire to Acquire Textileather and Bolta

General Tire & Rubber Co. has announced plans to take over Textileather Corp. and Bolta Co., two of the country's largest manufacturers of plastic film and sheeting. Under the proposed merger agreements, stock of the two firms would be exchanged for General Tire preferred, and General would operate the two companies as divisions of its plastics operation.

The contemplated transactions are subject to stockholder approval. No financial details of the deal will be revealed until plans are submitted to them, General said.

Continued on Page 72

Men in the News

Fruehauf Trailer Co. — Fred Burnham has been elected financial vice-president.

Nash-Kelvinator Corp. — **John G. Staiger** has been appointed an assistant comptroller.

Buffalo Weaving and Belting Co.— **George Schofield** has been made sales manager of the new Automotive Parts Div.

Fleet Mfg. Co., Ltd.—**Herman L. Eberts** has been elected president and general manager, succeeding **Daniel Robertson,** who has been made chairman of the board.

Muskegon Piston Ring Co. — Walter A. Clouser has been elected vice-president in charge of sales.

Robertshaw-Fulton Controls Co.— **Joseph C. McCarthy** has been selected as Canadian sales representative for the Robertshaw Thermostat, American Thermostat, and Grayson Divs.

Quaker Rubber Corp.—**C. L. Kenny** has been made manager of products.

Ajax Flexble Coupling Co., Inc.— **Thomas H. Brumagin** is now chief engineer.

General Electric Co.—**Frank M. Mansfield III** has joined the Carboloy Dept. as manager of product programming.

Bullard Co. — M. K. Peck has become an assistant sales manager.

Eaton Mfg. Co.—E. M. deWindt has been appointed general manager of the Stamping Div., while W. R. Eames is now general manager of the Pump Div.

Ajax Electric Co.—**John E. Haig** and **Leon B. Rosseau** were elected vice-presidents.

Pittsburgh Plate Glass Co., Ditzler Color Div.—**E. Dudley Kress** was named industrial sales manager, and **Earl H. Heaton** was made his assistant.

American Chain & Cable Co., Inc.—Clifford G. Strote has been appointed director of purchases.

Studebaker Corp.—**E. W. Pigg** has become Pittsburgh district manager; **J. H. Moor,** Buffalo district manager; **N. R. Erickson,** Minneapolis district manager; **T. W. Davis,** assistant to the regional manager in Chicago; **F. H. Jung,** New York district manager; and **C. W. Clifford,** Philadelphia district manager.

Plymouth Motor Corp.—**M. L. VanDagens** is now director of plans and training in the Sales Dept.

Evans Products Co., Heating & Ventilating Div.—**D. B. Lawrence** has been named assistant sales manager.

Lamb Electric Co. — Francis H. Gerlach is now manager of engineering.

Borg-Warner Corp.— John A. Drake has been chosen director of market research.

Marquardt Aircraft Co. — **Joseph Kramer** has been chosen assistant to the factory superintendent, and **Edward Wenzlik** is now manager of systems and procedures.

Necrology

Emerson J. Foag, 61, former Buick and Dodge advertising and sales executive, died Jan. 31, at St. Petersburg, Fla.

Willard Sherman Girvin, 60, chief metallurgist for American Brass Co., died Feb. 1, at Waterbury, Conn.

Charles N. Daus, 53, New England States sales promotion manager for Westinghouse Electric Corp., died Jan. 31, at Hartford, Conn.

John Dunphy, 71, former Yale & Towne Mfg. Co. executive, died Jan. 31, at Covington, N. Y.

L. A. Markham, 64, retired personnel director of the Chevrolet assembly plant at Janesville, Wis., died there on Feb. 6.

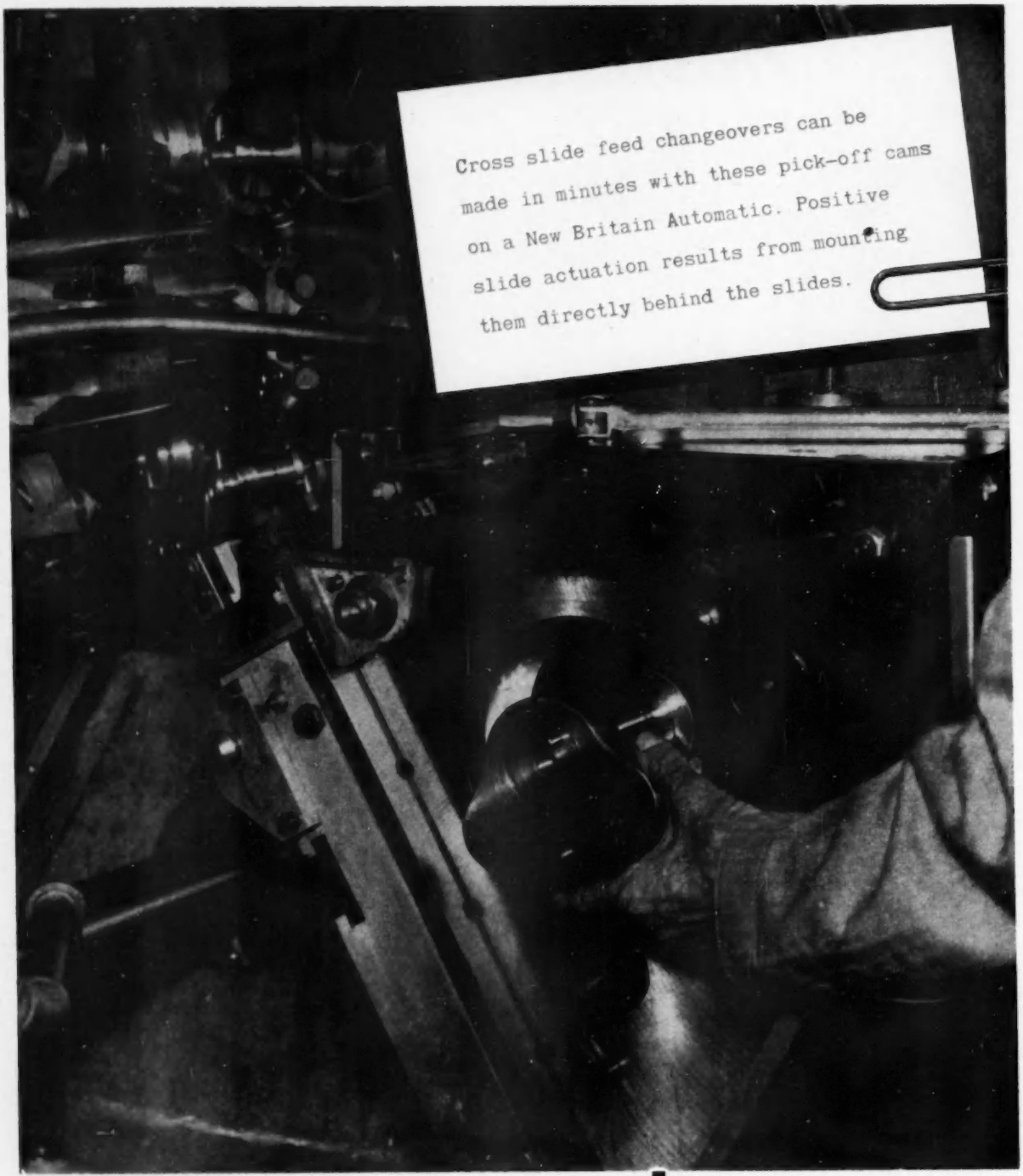
Charles J. Durban, 61, former assistant advertising director for U. S. Rubber Co., died Feb. 10, at Norfolk, Va.

Harald Hamberg, 62, chairman of AB SKF, died Feb. 7, at Gothenburg, Sweden.

George J. Zeis, 80, founder and owner of The Wiggler Co., died Jan. 29, at Buffalo, N. Y.

Ernest D. Grinnell, general traffic manager of Gaylord Container Corp., died Feb. 6, at St. Louis, Mo.

Arthur Duray, 73, veteran race driver and pioneer aviator, died Feb. 11, at Paris, France.



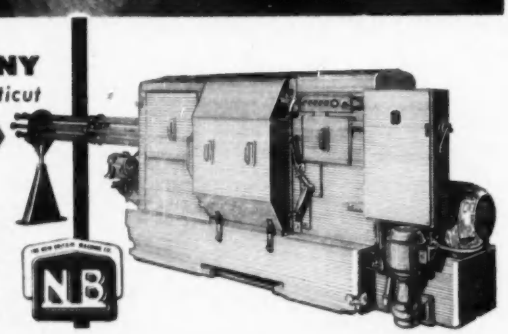
THE NEW BRITAIN MACHINE COMPANY

New Britain-Gridley Machine Division, New Britain, Connecticut

NEW BRITAIN *Automatics*

Machines for Making Progress

Automatic Bar and Chucking Machines
Precision Boring Machines
Lucas Horizontal Boring, Drilling and Milling Machines
New Britain +GF+ Copying Lathes



C-D-F INSULATING TAPES

Uniform strength and quality plus prompt deliveries!

C-D-F SILICONE TAPES for A.I.E.E. Class H Electrical Insulation. Available in Varnished Fiberglas cloth and Silicone Rubber-coated Fiberglas cloth. Resistant to high temperatures; high dielectric strength, low dielectric losses, excellent moisture resistance and high tensile strength. They resist mild alkalis, non-oxidizing acids, mineral oils, oxygenated solvents. Available in a range of sizes on continuous rolls. Write for Technical Bulletin #47.

C-D-F TAPES OF TEFLON* have the desired mechanical and electrical properties for heavy-duty motor, generator, and conductor insulation. Unaffected by temperature fluctuations, exposure to oils and greases, or weather conditions. Fiberglas supported and unsupported Teflon tapes are available in a range of sizes.

*du Pont trademarks.

C-D-F MICABOND TAPES have an inherently high and permanent resistance to heat with good dielectric properties. Micabond Tapes are used for insulating motor and generator armature and field coils, turbo-generator coils, and many similar applications where flexible high quality insulation of A.I.E.E. Classes B and H insulators are required. Available in a wide range of sizes with many different backings including: fiberglas, silk, cellophane, cotton, paper, and Mylar*.

If you have an insulating problem, probably a C-D-F product is the answer. C-D-F manufactures and fabricates electrical insulation, laminated and molded plastics. Sales offices are located in principal cities. Call your C-D-F sales engineer—he's a good man to know!

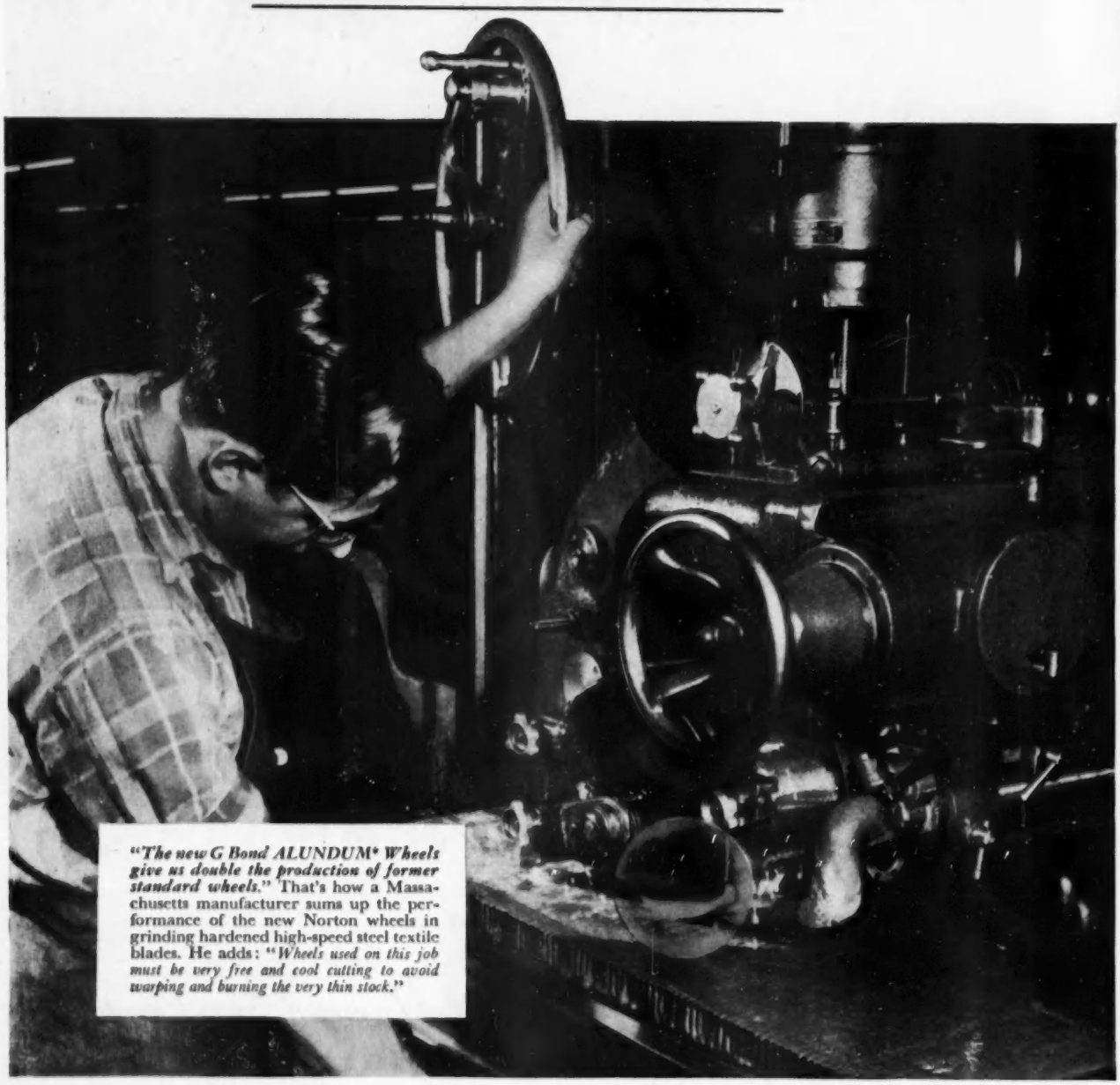
THE NAME TO REMEMBER... CDF SILICONE, TEFLON, MICABOND TAPES

Continental-Diamond Fibre Company

NEWARK 2, DELAWARE

These users say:

For surface grinding, the new G BOND beats them all!



"The new G Bond ALUNDUM* Wheels give us double the production of former standard wheels." That's how a Massachusetts manufacturer sums up the performance of the new Norton wheels in grinding hardened high-speed steel textile blades. He adds: *"Wheels used on this job must be very free and cool cutting to avoid warping and burning the very thin stock."*

Latest Norton wheels bring you the money-saving

"TOUCH of GOLD"

Naturally, we've kept close watch on how the new G Bond wheels are doing. And we can report that throughout the range of precision and semi-precision grinding applications they're already away out in front. In the field of surface grinding, for instance, a composite statement by users of the new G Bond would run very much like this:

"G Bond wheels cut freer, cooler, faster — enabling us to take heavier cuts in costly high speed steels without drawing temper. They give us closer tolerances and smoother finishes. They dress easier and produce more pieces per dressing. Doing more work and a greater variety of work — per wheel, they outlast any wheels we ever used before."

G Bond Wheels for YOUR Surface Grinding

will bring new speed and economy to surface grinding jobs — thanks to their unique grain-holding structure that produces greatly improved cutting action. Remember, the G Bond is the most modern, most efficient vitrified bond ever developed — a typical Norton "Touch of Gold" achievement that steps up grinding performance and product quality while cutting grinding costs.

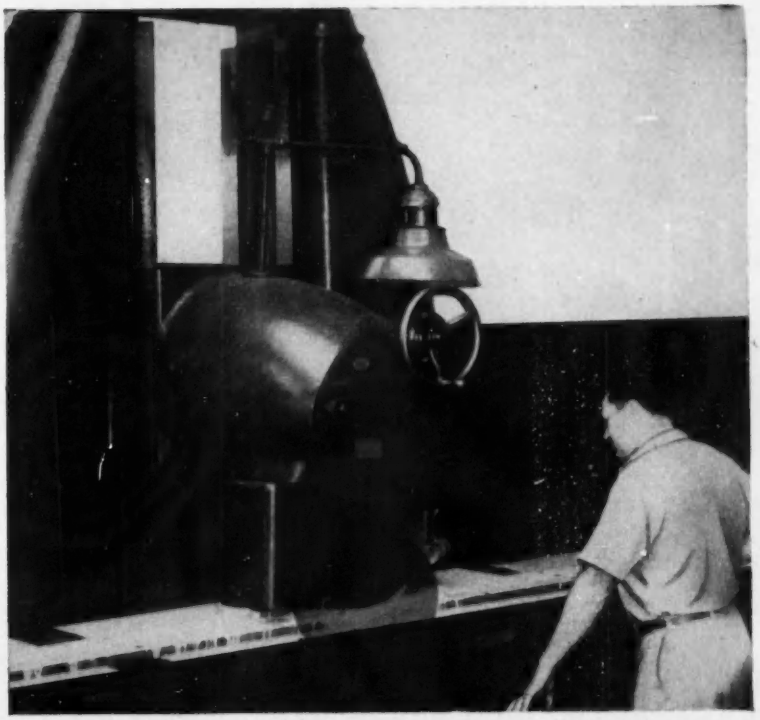
See Your Norton Distributor

for the ALUNDUM G Bond wheels, cylinders and segments you need. Or write to NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities, listed under "Grinding Wheels" in your classified phone directory. *Export:* Norton Behr-Manning Overseas Inc., Worcester 6, Massachusetts. W-1535

NORTON
ABRASIVES

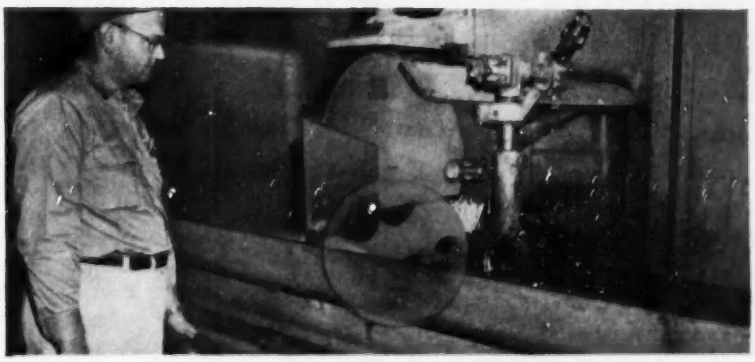
Making better products . . . to make other products better

*Trade-Mark Reg. U.S. Pat. Off. and Foreign Countries

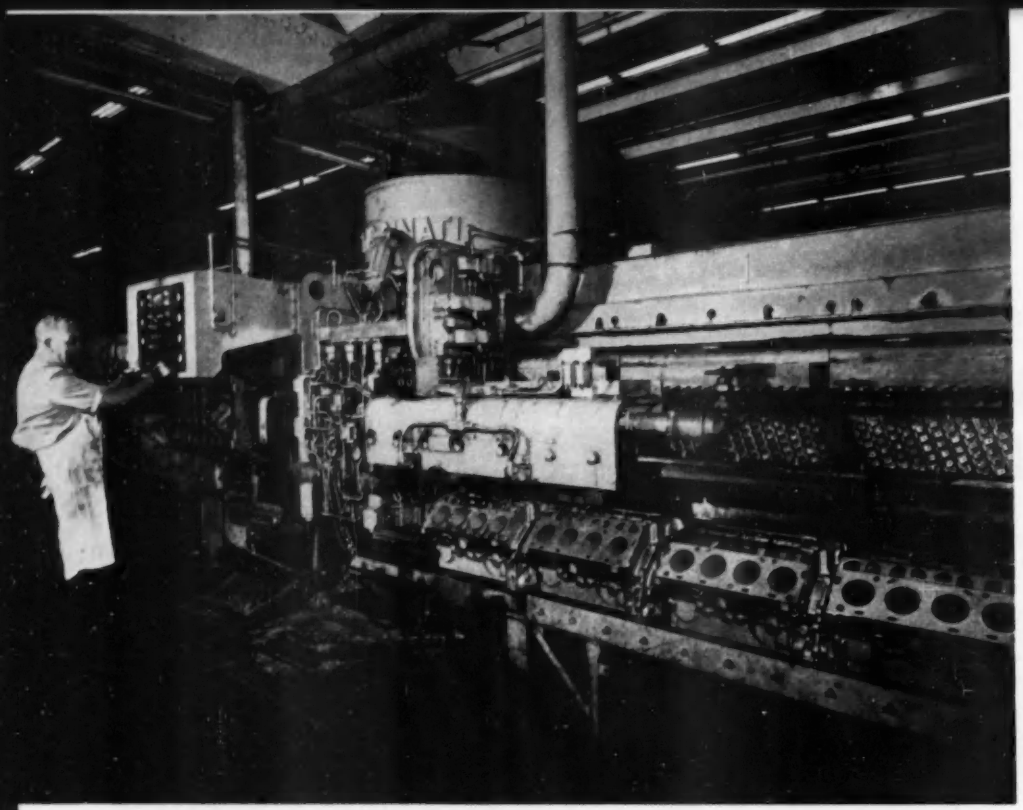


***"Thirty per cent longer wheel life**, freer and cooler cutting, a good finish and more pieces per dressing,"* are G Bond advantages cited by an Ohio machine tool company on this surface grinding job. Material on job illustrated is flame-hardened graphitic tool steel.

***"I get a fast cut and good finish.** They're the best and most versatile segments I ever used for this kind of work and I'm re-ordering ten sets,"* reports an Illinois customer using G Bond segments for surface grinding mild steel, cast iron and Meehanite — all three.



***"We're getting forty per cent more wheel life from G Bond wheels, and they cost us twelve per cent less because now we don't need a premium priced abrasive.** The new bond has proved excellent for grinding our laminated stainless steel and mild steel magnetic chuck plates."* This from a Michigan manufacturer.



This is a typical installation of the modern Cincinnati surface broaching machines on the Ford OHV-V-8 engine line. The one shown here is broaching cylinder blocks—handled in two machine operations on each line. Similar equipment is used on the cylinder head line.

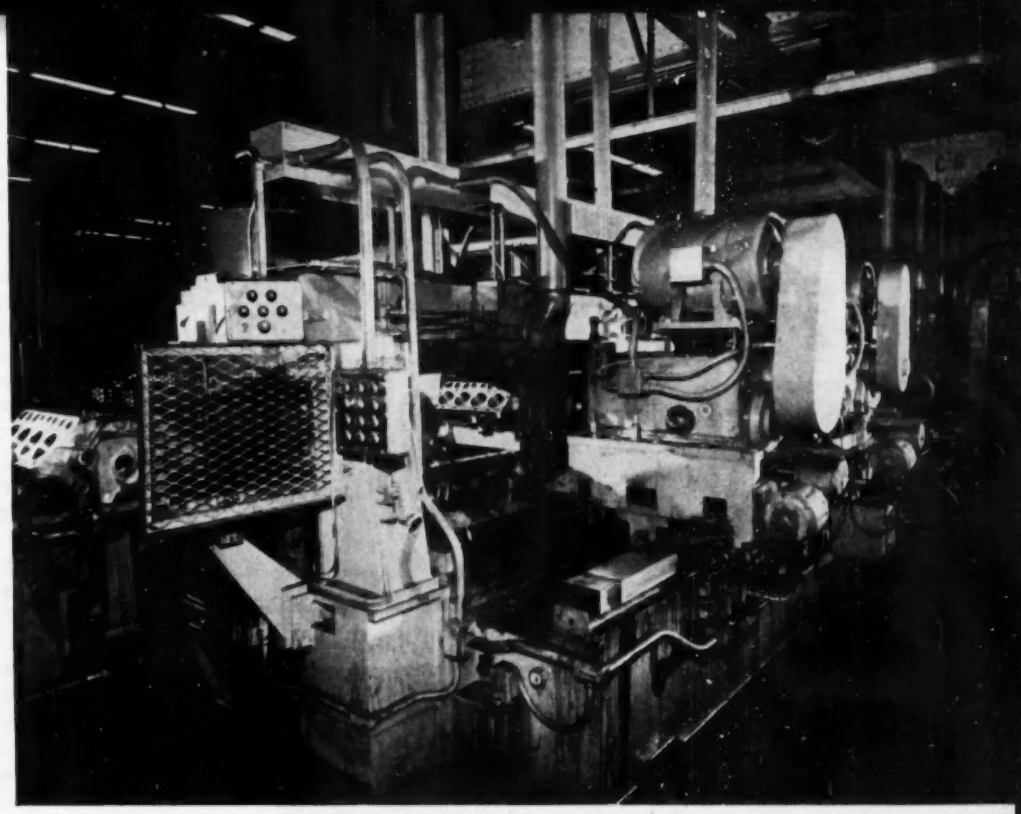
Latest Machines and Methods

THIS article, Which Is Part I in a Series, Is Devoted in General to Operations on the Cylinder Block and Heads for the New Ford OHV V-8 Engine. Part II Will Describe Automation Details for Engine Assembly, Testing and Shipping. Automation Features in the Crankshaft Department Also Will Be Discussed in the Second Part of This Article Which Will Appear in an Early Issue of AUTOMOTIVE INDUSTRIES

ESTABLISHMENT of production facilities for the new Ford overhead valve V-8 engine at Dearborn has provided the setting for the latest development in automation, resulting in another major advance in the art.

As recorded in AUTOMOTIVE INDUSTRIES in a series of articles published during the course of the last year or so, Ford's Cleveland Engine Plant represented the most extensive application of automation techniques up to that time, reaching every phase of the operation and including one of the first examples of a completely automatic power-and-free conveyor system for engine assembly, testing, and shipping.

The experience in Cleveland from the standpoint of effectiveness and maintenance made it possible to visualize further improvements as well as simplification of many details when planning automation for Dearborn. For one thing, lateral movement of work on conveyor lines has been reduced or completely eliminated, thus making unnecessary the installation of the complex turntable and roll-over fixtures at corners. There is another noteworthy advance of major significance. All of the newer transfer machines have been designed to incorporate an extension of the transfer mechanism at the last station. This makes it possible to link the exit end of one machine to the loading end of the succeeding machine without resorting to



View of two special Sundstrand milling machines for operations on the cylinder block. The first one rough- and finish mills the front and rear faces; the other mills the bearing lock line as well as sides of bearings.

at Ford's Dearborn Engine Plant

employment of a special automation link between them.

Automation has been extended even more effectively in linking operations in the crankshaft department. An outstanding example of what can be accomplished, this will be described and illustrated more in detail in Part II to be published soon.

Still another noteworthy advance in automation is the latest installation of Mechanical Handling Systems power-and-free conveyor network for transporting the engine along the final assembly lines, through the paint department, through the "hot" test block setup, and out to the shipping dock. It is of interest that Ford has adopted practically 100 per cent the installation of the now familiar Cross Tool-O-Matic control boards serving all of the transfer machines on the Ford V-8 lines.

Let us consider the cylinder block department. Castings as received from the foundry are stored in banks at the start of the line, then fed to a network of short lateral conveyors which feed a single heavy duty conveyor serving the first operation. Feeding of blocks to the primary conveyor is done by automation in a completely automatic cycle, timed with the cycle of the machines.

Before entering machining operations, the blocks go through a qualifying fixture to make sure that a minimum amount of stock is available at all points to clean up properly. This department has three similar lines of each type of equipment to handle the required volume of production.

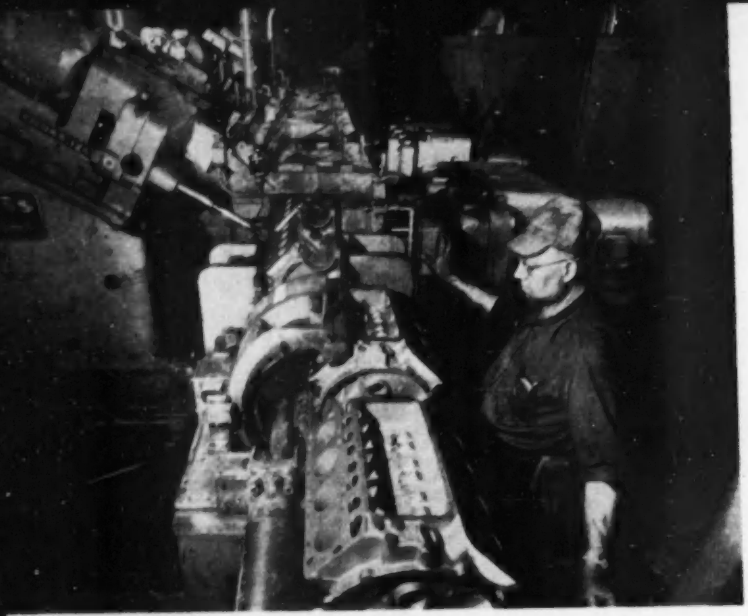
First major operation is surface broaching. For this purpose, Ford has two of the big Cincinnati horizontal surface broaching machines for each line. The first unit broaches the two cylinder banks, the second unit broaches the parting line as well as the half-round for main bearings.

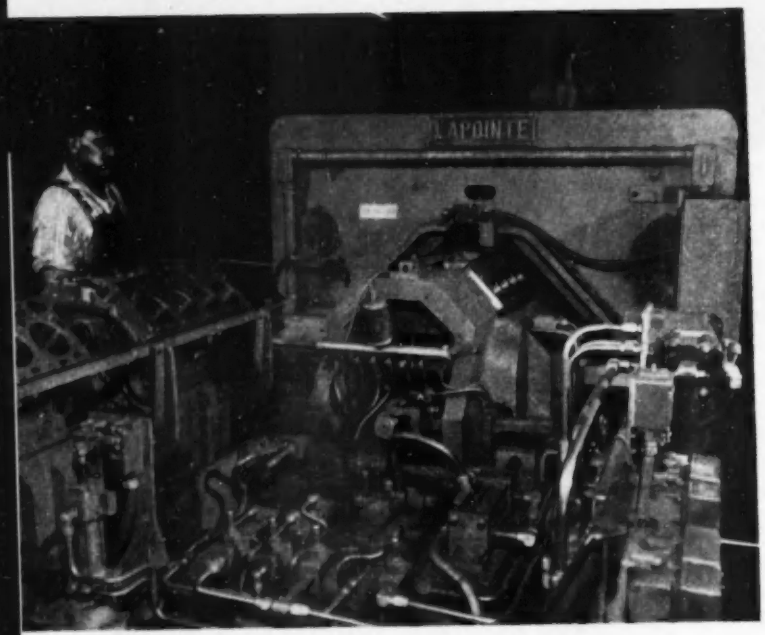
Each of the new transfer machines now is provided with automatic inspection stations at control points to be noted later. This is the feature that makes it

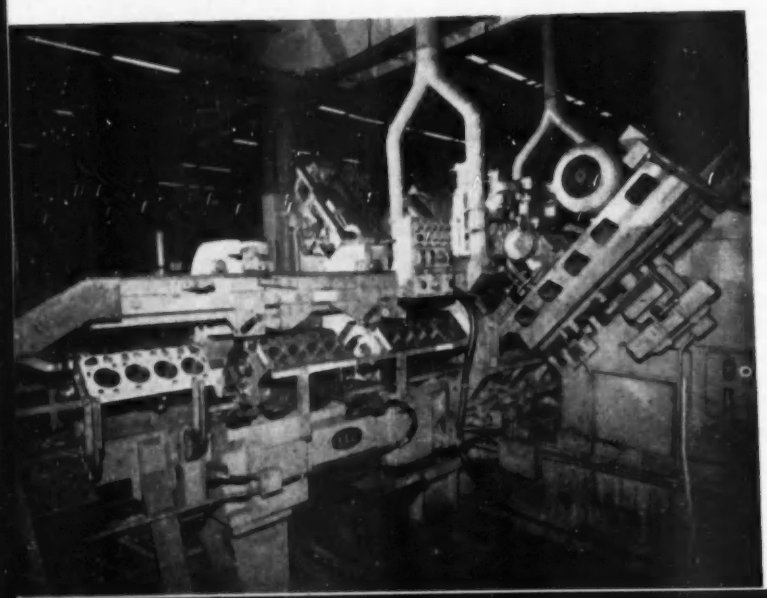
By Joseph Geschelin

possible to achieve completely automatic cycling throughout the entire department, just as if it consisted of a single gigantic machine.

Following surface broaching, there are three parallel lines of 19-station Cross TransferMatics. Each one handles the following group of operations: drill, spotface, and counterbore the distributor shaft hole and locking bolt hole; drill and countersink valve chamber and throttle mounting holes; drill and ream two locating holes in pan face; drill and ream dipstick hole;







drill and countersink oil pan and main bearing holes; drill, countersink, and ream oil pump pad holes; drill one angular oil supply hole; drill four main bearing oil holes.

This machine has 100 spindles in action. At Station 4, there is an automatic inspection station for the two locating holes; at Station 17 the block is rotated and vibrated to dump chips; while Station 18 inspects five holes on the left hand side, and 28 holes for tap depth on the right hand side.

This is followed by a battery of two special Sundstrand milling machines of transfer type. The first rough- and finish-mills the front and rear faces of the block; the other mills the bearing lock line as well as the sides of the bearings.

Three lines of 17-station Footburt transfer machines with 80 spindles in action are next in line. Each one takes the following group of operations: drill, ream, countersink, and counterbore holes in top of both banks; drill one oil supply hole in each bank; drill and ream dipstick hole; drill oil breather tube hole; drill and countersink mounting bracket holes, rear locating pad, horizontal water drain hole, breather mounting pad holes, and oil pressure unit hole.

These machines, too, are provided with suitable inspection stations. Station 10 checks 10 holes and one oil supply hole on right- and left-hand sides simultaneously. At Station 16 the block is tumbled to remove chips. Station 17 automatically inspects five holes on the left side and three holes on the right.

It may be noted at this point that only a sampling of the equipment in this department is covered. Consequently, there are gaps in the sequence of operations that will have to be taken for granted. For example, another Footburt transfer machine follows the one mentioned above.

A group of three three-station Ex-Cell-O precision-boring machines are employed for

TOP—Overhead view of one of the 19-station Cross Transfer-Matics with 100 spindles in action on various holes in the cylinder block.

MIDDLE—All cylinder blocks are routed through LaPointe tunnel type surface broaching machines for a finish cut on the cylinder banks. Cylinder heads are treated in similar fashion on the same make and type equipment.

BOTTOM—Here cylinder blocks are entering one of the Ex-Cell-O three-station precision-boring machines, loading and unloading being done entirely by automation.

semi-finish-boring of cylinder bores immediately following rough machining operations.

Another outstanding piece of equipment is the 11-station Greenlee transfer machine, with 109 spindles in action, for tapping all holes in the block. A special cutting fluid is used for this operation. Because a single machine is employed for tapping all holes, it is provided with three built-in turntable stations for turning the work 90 deg at a time. In addition, there is a turntable station directly outside the exit end to index the block properly for the next operation.

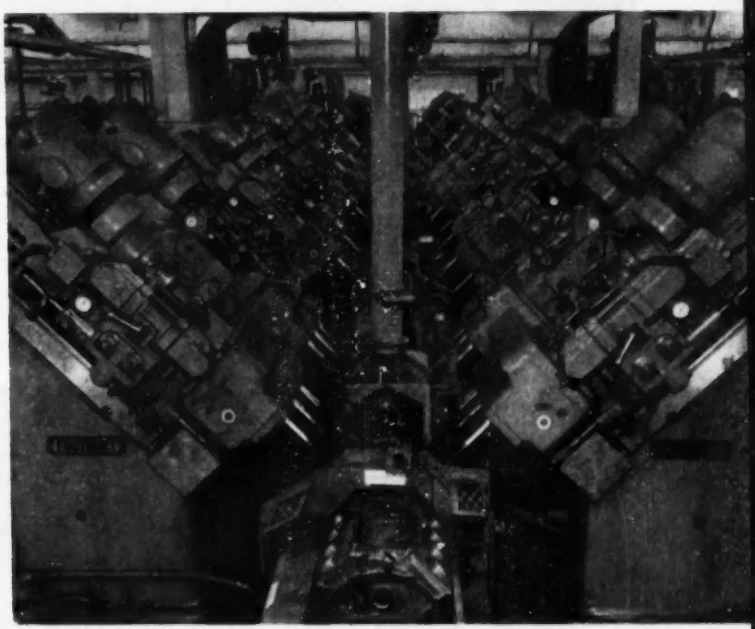
An installation of special Expert machines, connected by automation links, is used for pressing-in the Welch plugs.

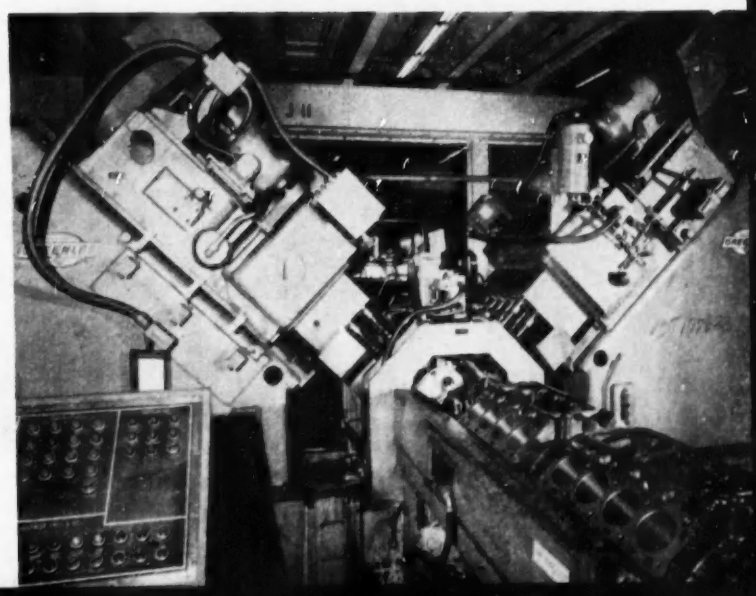
Just before the final stages are approached, and following washing of the blocks, the work enters LaPointe tunnel type surface broaching machines for a finish cut on both banks, removing about 0.010 in. of metal, and removing at the same time all scratches and nicks accumulated during the trip around the circuit.

Blocks then enter another battery of Ex-Cell-O precision-boring machines for finish-boring of cylinder bores. Final major operation is the honing of cylinder bores in a battery of Barnesdrill, V-type honing machines. Finish-honed bores are accepted in a range of eight standard bores, varying in steps of 0.0001 in., within an acceptable band of sizes.

Blocks then are given an air test for tightness, and proceed to a visual inspection line where repairs and corrections are made off the line in the case of rejects for cause. Then the accepted blocks are hooked onto a monorail conveyor for transport to the start of the engine assembly line on the floor above.

Following are a few selected operations on cylinder heads. In this case all rough castings are given a target inspection but the job is done in the foundry before de-

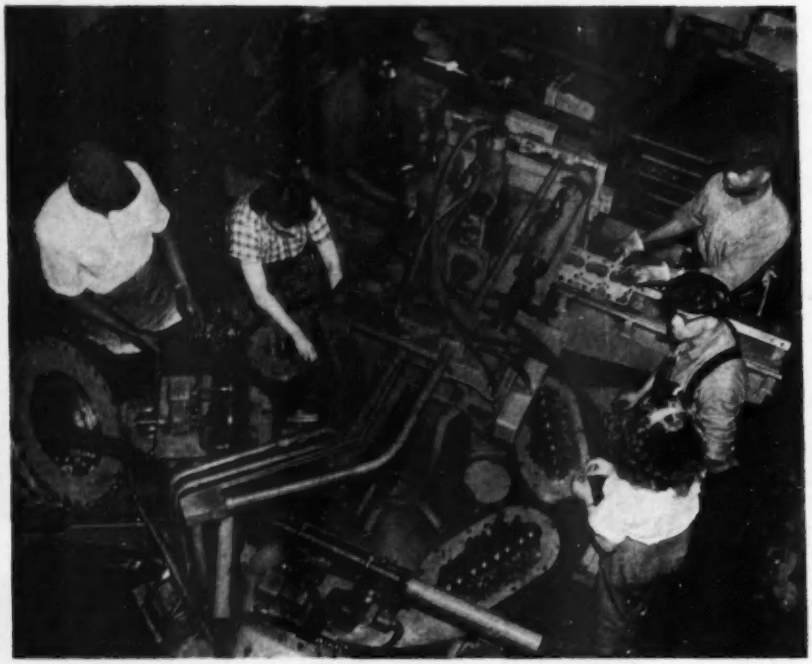




TOP—Perspective of one of six rows of 17-station Heald transfer machines, each with 104 spindles in action—for operations on valve guide holes, valve seats, etc.

MIDDLE—Perspective view of 17-station Footburt transfer machine with 80 spindles in action on the cylinder block. Note the array of heads all inclined for operations on the cylinder banks.

BOTTOM—Loading station of 11-station Greenlee transfer machine, with 109 spindles in action for tapping all holes in the cylinder block.



Overhead shot of special automation machine for cylinder head assembly. Heads are loaded into the fixture in the background, then transferred automatically onto the fixture on the table. Operators in the foreground are engaged in keeping the table fixtures loaded.

livery to the machine line. Although there are less operations on the head, production quantities are at least double those of the block and Ford has provided five rows of similar equipment—in the majority of cases—to handle the projected volume.

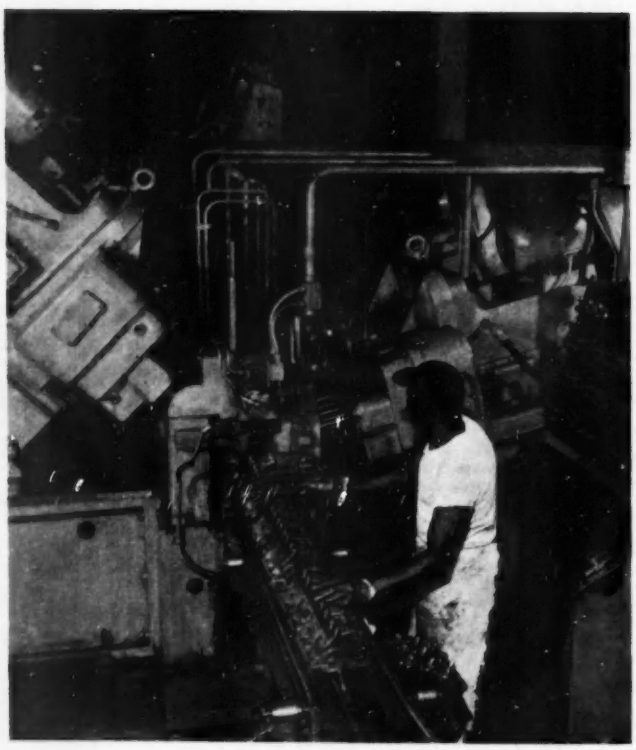
As in the case of the block, the first operation is on the huge Cincinnati surface broaching machines. Here there are five rows, each with two machines in series. The first machine finishes the three faces at the top of the head; the second machine finishes the gasket face. An automatic turntable station on the conveyor at the exit end of the second machine indexes the head properly to meet the next operation.

Next in line is a 19-station Footburt transfer machine of fixed center type with hydraulic feed. With 119 spindles in action, this unit handles the following operations: mill end pads; drill and spotface bolt and pushrod holes; drill and countersink rocker arm bracket holes; drill oil holes; rough-machine intake and exhaust valve seats; faces, and throat; drill valve guide holes part way; drill oil return holes. Due to the disposition of holes in the head, the machine is replete with heads mounted in various angular positions as well as horizontally and vertically.

It also features a number of inspection stations. Station 10 checks the ¼-in. oil hole; work is tumbled at Station 16, and 18 holes are inspected at the same station; the left hand head at Station 18 checks eight holes; at Station 19 the head is indexed 18 deg to place the valve holes in a horizontal position for the next transfer machine.

Although the majority of the equipment on the head is arranged in five rows, it was found necessary to install six rows of 17-station Heald transfer machines in view of the slower cycle required for its particular duty. With 104 spindles in action, these machines perform the exacting job of semi-finishing and finishing all valve guide holes,

(*Turn to page* 78, *please*)



One of five rows of 27-station W. F. & John Barnes transfer machines each with 77 spindles in action for various operations on cylinder heads.

New Engines for British Rover Cars

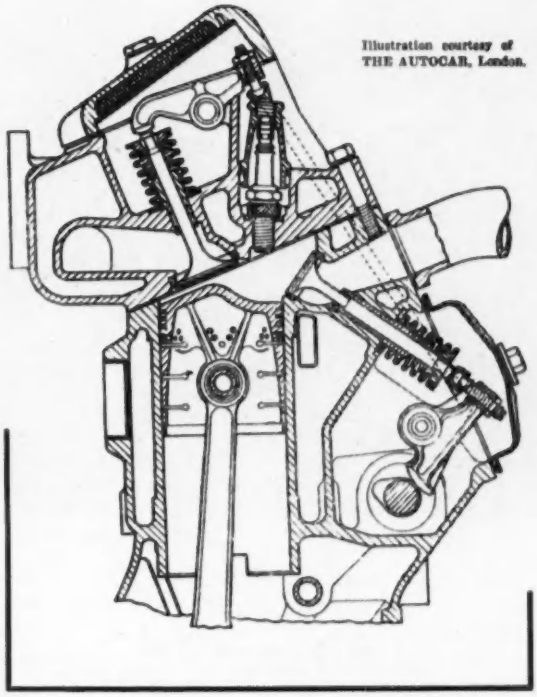


Illustration courtesy of THE AUTOCAR, London.

THE Rover Company, Ltd., Birmingham, England, has recently brought out two new engines for use in its passenger cars. They are known as the 60 and 90 models and supplement the 75 model which is continued in production with a few minor changes.

Shown here are some of the features of the Rover 60 engine, a four cylinder unit of the same design as the other two which are sixes. Note that the cylinder block is machined at an angle of 20 deg and the combustion chamber is formed below the flat cylinder head. This design is said to provide excellent cooling for the exhaust valves and ports, and to permit large intake valves to be used. Location of the spark plug is as near as possible to the center of the combustion chamber and good scavenging is attained at the spark plug area.

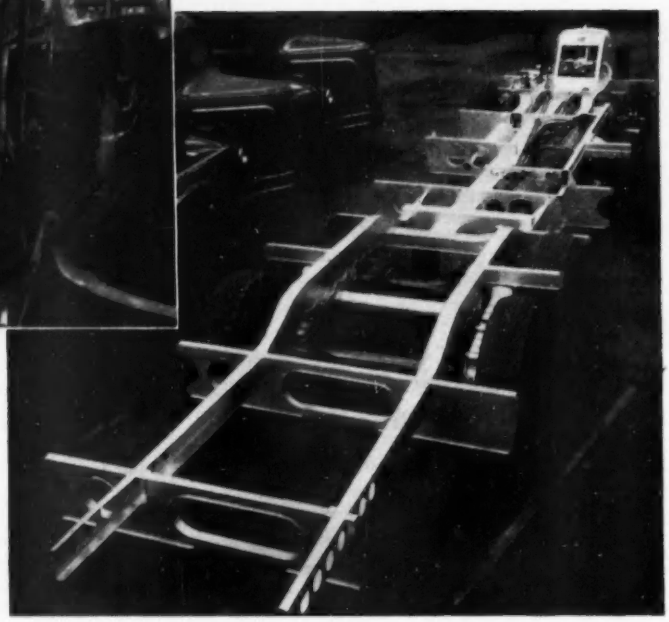
Jet Engine Blades Trimmed by Friction Sawing

TRIMMING rotor blades made of SAE 410 stainless steel by the abrasive method was formerly a problem at the Robbins Engineering Co. of Detroit. The operation was extremely slow and heat penetration was terrific and thus made the subsequent grinding operation more difficult due to having to remove that much more material. As illustrated, the job is now being expedited on a DoALL 36-R band machine equipped with an auxiliary table. A DoALL friction saw one in. wide—14 pitch, which is especially designed for this process, is being operated at a velocity of 7000 fpm.

The rotor blades are cut before being permanently fixed in place, then anchored to the turbine and finally ground. Fixturing is most simple, consisting mainly of a square steel plate fitted with a pivoting stud. The dimensions of the fixture are based on proper thickness for clearance and so that after turning down one-half of the thickness, the plate will be circular except for corners so it may be readily positioned and bolted to the auxiliary table. The average life span of each friction saw band is 12 rotors, which is equivalent to the cutting of approximately 18,000 rotor blades.

Band saw equipped with auxiliary table for trimming rotor blades.

At left is assembly line in the Berliet plant showing body frame members before installation of paneling.



At right is seen one of the three-axle versions of the Berliet chassis with lengthened rear frame assembly.

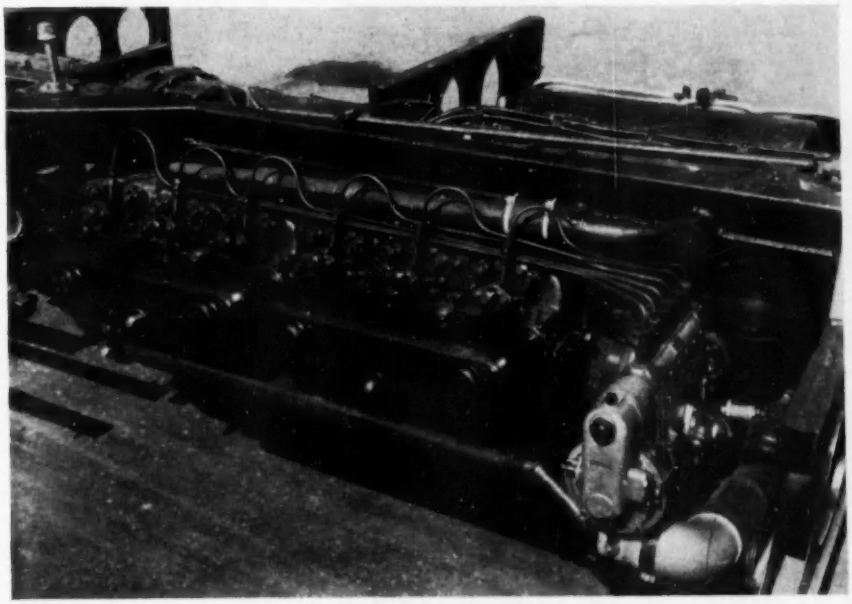
Berliet Buses Have Frame of Unique Design

USUALLY high chassis rigidity together with light weight are outstanding features of the underfloor engined bus now in production by the Berliet Co., of Lyons, France.

The basis of this chassis frame is a central box-section beam, to which cross members 15.7 in. in height are welded. While described as a central beam, this structure is 6.5 in. offset from the chassis longitudinal axis to provide for the installation of the horizontal six-cylinder Diesel engine. The beam, which has a length of 215 in. and a section of 11 by 11 in., is pressed from a steel plate about 9/64 in. thick, forming a U-section, the open face of which is covered by an arc welded plate of the same thickness. The Berliet design allows use of much lighter gage steel than does the usual type of frame. The backbone is the heaviest component, most of the other frame members having a thickness of 5/64 in.

The chassis frame consists of three sections: a central portion carrying the engine, clutch, transmission and front axle; a forward unit comprising essentially two box section rails of 5.5 in. by 5.5 in.; and a rear assembly composed of two up-swept side rails, in box section, with a mean height of 6.69 in., increasing to 15 in. over the rear wheel arches. There are eight cross members, each 15.7 in. high. All the cross frame members are pressed out of 5/64 in. plate and are welded to box section. To reduce weight, round holes are punched in the cross members. In a few cases the vertical surfaces are brought together in a press and joined by welding, but much more frequently a ring is inserted and welded to the two faces. To provide for mounting the flat engine, there is a fore-and-aft rail, also in box section, parallel to the main beam. There is practically a complete absence of gussets in this construction.

The body is of all-steel, stressed-skin construction built up of box section frame members, with welded-on inner paneling and riveted outer sheathing. A feature of the body construction is the high degree of standardization of the frame members. There are eight uprights on each side, united by ceiling hoops. All of



Mounting of horizontal Diesel in chassis. The box-section frame member above the engine is parallel to the central beam

these are square welded steel tubes, 1/16 in. thick and 1.3 by 2.1 in. section. The stringers, uniting the uprights, are the same. The principal body parts are two side panels, the roof, front and the rear panels and flooring. These are produced on lateral assembly lines, electrically welded in jigs and brought by overhead crane to the main assembly line.

Each of the eight chassis cross frame members has a groove formed in its outer edge to the full height of 15.7 in. The box-section uprights of the side panels are inserted in these grooves and welded to them over the entire height.

This type of construction gives a certain amount of freedom in body design and allows for custom-built bodies. The only obligation imposed on the body builder is the welding of the body to the cross frame members. The position and number of doors, seating accommodation, baggage capacity, etc., can be modified without any great change in tooling. All buses have a wheelbase of 219 in., an overall width of 98 in., and an overall length of 423 in.

The Berliet production program is a series of Diesel engines with four, five or six cylinders, all having the same bore and stroke—4.7 in. by 5.5 in.—with the maximum number of interchangeable parts. Derived from these are two horizontal engines—a five and a six—with detail changes covering position of the injector pump, air compressor, water pump and oil sump. Crankshaft bearing dimensions are the same throughout. There are two gasoline engines, but production of these is low. For the series of buses for Chile, the six-cylinder engine has been selected. Provision is made for fitting the five-cylinder engine in this chassis without any structural alteration.

Developing 150 hp at 2200 rpm, cylinders and crankcases are a single casting, the case extending below the crankshaft line for increased rigidity. Main bearings have a diameter of 3.77 in., the lengths being 1.8 in. for four of the main bearings and 2.63 in. for the other three. Connecting rod bearings have a diameter of 3.54 in. and a length of 1.96 in. The crankshaft, which has forged counterweights, is hardened to a depth of about 3/16 in. to allow for several grindings without a loss of hardness. The wet cylinder liners are centrifugally cast in a chrome-nickel copper alloy, and are held by a collar on the head, with a synthetic rubber ring for the base joint. The light alloy pistons carry two upper chrome plated rings, a third ring treated by the Sulfinuz process and two Ondulex oil rings, one above and one below the piston pin. The exhaust valves have an electrically welded head of austenitic steel, with a stem in silicon-molybdenum, and have inserted steel seats. The intake valves seat direct in the iron head. Combustion takes place in a double turbulance pre-combustion chamber, under Ricardo Comet III license. Compression ratio is 16.5 to 1.

For engine lubrication a double oil pump is driven off the crankshaft, the main high-pressure pump feeding the main and connecting rod bearings while the second pump delivers oil at a lower pressure to the overhead valve gear and the auxiliaries. Placed to the right of the central beam, the engine has its head outwards, with the pump injector placed at right angles to the longitudinal axis for greater accessibility. The engine is attached by means of crankcase lugs passing through three long studs from the main beam and the parallel longitudinal frame member, and can be raised or lowered for positioning by means of three screw jacks. Heavy rubber pads are inserted between the engine lugs and the frame seats. For the horizontal model the water pump, fan and air compressor have been separated from the engine and moved forward to form a unit at the front end of the chassis, immediately behind the radiator. An open shaft, coupled up to

By W. F. Bradley
Special European Correspondent
for AUTOMOTIVE INDUSTRIES

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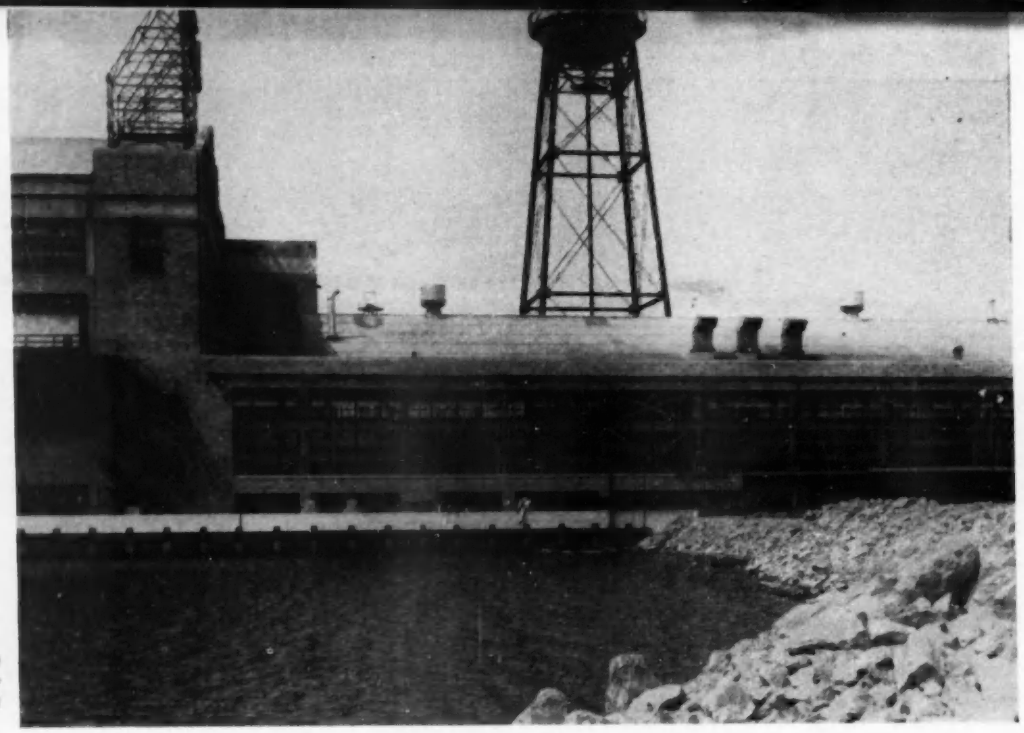

Portion of the dike which protects Ford's Long Beach plant.

The Sinking Factory

By James Joseph

WHEN management at Ford Motor Co.'s Long Beach, Calif., assembly plant talks about keeping its head above water, it means just that. Since 1937, the 75-acre plant site has sunk 11.6 ft. The reason: subsidence.

Yet despite this, plus a horizontal displacement of nearly three ft in the direction of the subsidence's center, not one production hour has been lost. The plant still maintains its normal pace.

The subsidence problem is an old one for the Long Beach Harbor area. First indications came as early as 1937. By August, 1953, some areas had dropped 17 ft, with estimated maximum sinkage by 1967 (when engineers predict subsidence's cessation) put at 22 ft.

Ford assembly lines are currently 1.7 ft below harbor level during low tides, nearly four ft below at the year's maximum tide. Save for a network of dikes, Long Beach harbor would have inundated the plant back in 1950.

The problem, while local in nature, has affected some other automotive plants across the U. S., particularly in areas of heavy subterranean mining. Actually, subsidence deceleration is in sight, if recent figures are indicative. At the harbor's point of greatest annual subsidence, engineers have found that from November, 1950, to November, 1951, sinkage amounted to 2.37 ft. Yet from August, 1952, at late 1953, sinkage was only 1.696 ft.

Meanwhile, Ford and some harbor area aircraft plants have contributed to the $40 million already spent to hold back the sea. Ford alone, in three dike projects, has invested over one million. Yet this investment is small compared to its plant worth. Very few harbor area industries even consider moving, since this would be more costly than to guard against damage by subsidence.

Already a $120 million program has been launched—financed by industry, oil operators and public agencies—to span the 24-year period until 1967. This represents a yearly outlay of $5 million, or about one per cent per year of the affected properties' total $50,000,000 evaluation.

Plant engineer C. H. Culbertson, of the Ford plant, has waged an almost Hollandish engineering battle against water encroachment. Three systems of dikes protect the plant. There's a 1000-ft earthen dike containing a clay-core cut off wall faced on its seaward side by rock rip-rap. Guarding the plant's wharfage are 900 ft of sheet steel pilings, currently 10 ft, 8 in. above mean low water. This dike is being heightened this year, at a cost of about $300,000, to 16 ft. A shorter 250-ft section of the original earthen dike was replaced with steel piling in 1952, raising it to the 16-ft level.

This concrete-capped pile wall will be raised by the addition of sheet steel works, to a height of 16 ft. The large pipes carry storm water into the bay. Plant foundation is below water level.

Here Is the Story of What Is Being Done to Hold Back the Sea from Ford's Long Beach Assembly Plant

Plant engineer C. H. Culbertson inspects typical steel sheet piling at Ford's Long Beach plant.

If engineering data is correct—and recent sinkage decreases seem to bear them out—Culbertson's headache is lessening. Nonetheless, the plant's below-water-level location led to revision of its storm water drainage system. Previously storm water flowed by gravity to the harbor. Now, however, a special pump house and sumps have been built at dike's edge. Three 7500 gpm centrifugal pumps, powered by 75-hp electric motors work automatically and intermittently, actuated by depth-adjustable mercury switches in the sumps. One pump is also tied to a Ford V-8 engine, and can also be manually operated. It's designed for standby—in case of power failure.

Thus far two types of dikes have proved successful: the clay-core, cut-off wall; and steel sheet pilings. Steel sheeting is more expensive than earthen and rock works, but requires less space.

The 1000-ft cut-off wall consists of a pyramidal dike, 30 to 40 ft wide at its base and 25 to 30 ft wide at the top, depending on its height. A 4-ft wide trench is ditched by a special machine, through the center of this dike to the subterranean cap level and back-filled with special oil well waterproof clay. The outboard or seaward side of the dike is faced with heavy rock.

The frontal dike extension, now under construction, consists of sheet steel piling which will be driven tight against the face of the concrete cap on the existing piling, raising dike level to 16 ft above mean low water. Since the older dike was made from Z-type piles, the newer DP-2 piles will form voids. These will be filled with concrete, making the new wall integral with the existing wall and extending above the present dike's concrete capping.

Culbertson feels that the worst of his troubles may be over. For example, between November, 1951, and November, 1952, Ford property sank 1 ft (plus); yet between August of 1952 and of 1953, the subsidence rate declined to 0.89 ft.

In anticipating subsidence and thus dike levels, an estimated sinkage-rate map compiled by Long Beach Harbor engineers is used. The map indicates by segments just how much subsidence has taken place and the expected maximum sinkage, starting at the most heavily affected center. This center lies but a scant mile from the Ford plant. The Ford property falls within boundaries which showed the one-year sinkage rate from August, 1951-1952, to be 1.4 to 1.6 ft, and that expected maximum subsidence (by say 1967) will reach 14-16 ft. So far the engineer's estimates have been correct. Yet the Ford plant's sinkage is considerably less than in the most heavily subsided

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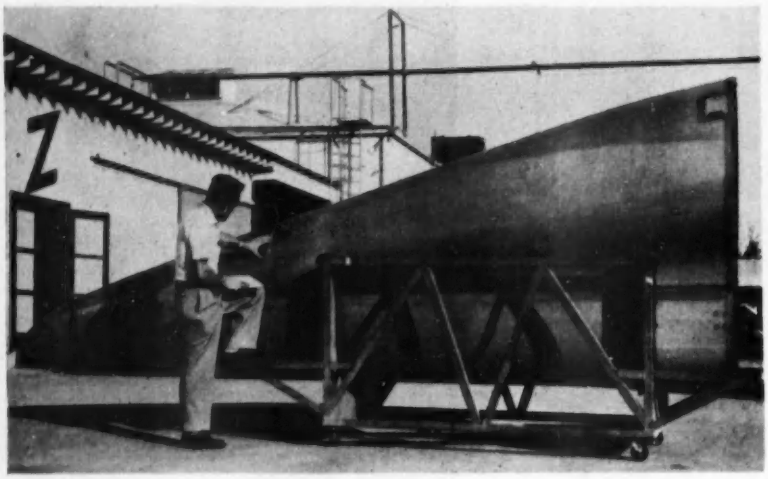
Current Developments Discussed at Reinforced Plastics Meeting



Tail section 17 ft long produced by Zenith Plastics Co. for the Navy's Neptune patrol bomber. Bakelite resins are used in conjunction with Fiberglas.

CURRENT thinking in industry is placing more and more emphasis on the role of reinforced plastics for tooling and as a basic fabricating material. This was shown in an impressive manner when well over 1200 registrants assembled in Chicago last month for the Ninth Annual Meeting of the Reinforced Plastics Division of the Society of the Plastics Industry.

Included in the registration lists were plastics specialists representing molders, fabricators, material suppliers, and equipment makers. There were several steel companies represented and most of the passenger car producers, as well as independent body manufacturers and others from industry who believe that reinforced plastic materials may be the answer to present or future production and design problems.

Large delegations were on hand from the big chemical companies and resin makers; in fact, one chemical firm registered 38 persons for the three day affair. Never before in the history of the entire organization has any divisional meeting enjoyed such a large attendance at a technical conference.

In addition to the technical meetings, this large enthusiastic gathering witnessed the Division's biggest display of products made of laminated glass fiber and resin. Items ranged from tiny parts to huge aircraft sections, an all plastic tank trailer for hauling milk, and three plastic bodied automobiles. The first major commercial production of the plastic-bodied Corvette, molded by Lunn Laminates and Molded Fiberglas Body Co., represented one of the most important industry milestones reviewed at the three day meeting. Two other sports car models were displayed: Kaiser Darrin, molded by Winner Manufacturing Co.; and Alembic II, molded by Glasspar.

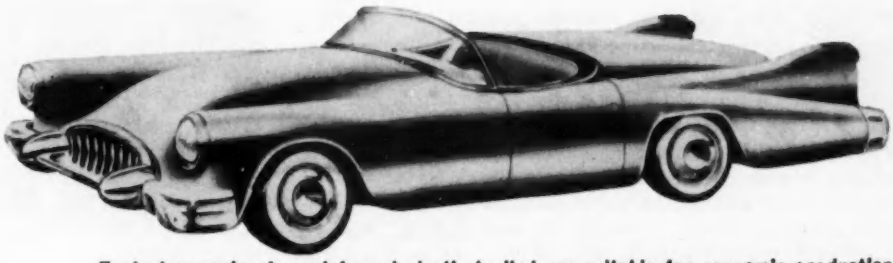
The single piece plastic milk truck trailer tank has a capacity of 4000 gal and has a dry weight of 7000 lb. It is 27 ft long, 58 in. high, and has a circumference of 18 ft. Resins produced by the Marco Products Dept. of Celanese Corp. were used to manufacture the tank.

Zenith Plastics Co. exhibited a 17 ft long tail section for a Navy Neptune patrol bomber. The piece is used to house the tail weapons of the military plane used for anti-submarine warfare. It is molded of polyester resins developed by the Bakelite Co., and uses Fiberglas. This development is said to mark the first large fuselage structure molded of reinforced plastics manufactured on a mass production basis as an integral part of the aircraft design.

One of the highlights of the technical sessions was the talk given by E. James Premo, chief body engineer, Chevrolet Div., GMC, on the Corvette car. Mr. Premo pointed out that the current break-even point on a cost-per-unit basis between reinforced plastics and steel is about 15,000 cars with the use of matched metal dies. If more than that number of bodies is to be produced, metal is much less expensive.

During the course of the meeting, many new and experimental resins were discussed by representatives of the makers. Pittsburgh Plate Glass Co., covered three commercial Selectron resins and one experimental product. One of these is for matched metal dies, while another needs only the catalyst. The third commercial resin has been made to provide increased color stability. A fire retardant resin with good physical properties is the last of the group.

By Thomas Mac New



Typical example of a reinforced plastic bodied car suitable for economic production up to 15,000 units utilizing current production techniques.

Four resins also were discussed by the U. S. Industrial Chemicals Co., Div. National Distillers Products Corp. These products were a light stable self-extinguishing resin, two new low cost resins, and a flexible resin for high impact qualities.

Rohm and Haas Co. presented information on two resins introduced last year, a modified resin for light resistance, and a new binder resin for preforming.

An air-uninhibited resin with good impregnating values was the subject of The Glidden Co. A gel-kote resin with surface finishing and overlay qualities also was reported by the company.

Hooker Electrochemical Co. pointed out the characteristics of its fire resistant, high-strength resins. These resins use a new, stable, chlorine containing dibasic acid in their structure.

Laminac resins, product of American Cyanamid Co., were discussed in respect to the broad field covered by this group. The six resins reported on were: a non-yellowing, clear, fire resistant type; a resin with excellent electrical properties at high temperature; a solid polyester type for preimpregnation application; a non air-inhibited type having low temperature curing characteristics; a resin having good strength properties on long exposure in boiling water: and a heat-resistant, foam-in-place polyester resin.

Silicone resins were dealt with by Dow Corning Corp. This firm has brought out four new silicone resins in the past year. They are a low pressure resin with increased strength, a resin with good electrical qualities at high temperatures, and both rigid and thermoplastic foaming resins.

Improvements in thermal resistance and chemical resistance of polyester resins and liquid phenolics produced by General Electric Co., were the subject of that company's contribution to the program. It was stated that these materials were improved at reasonable cost.

Subject of Narmco, Inc., was the latest developments in the field of high temperature structural adhesives produced by the firm.

Three types of Polylite polyester resins were the topic of Reichhold Chemicals, Inc. These resins are of the light stabilized type, the fire-resistant type, and the non-air inhibited type.

U. S. Rubber's Naugatuck Chemical Division reported on the recent developments in the Vibrin resins in respect to automotive and light stabilized types. As a matter of interest, it was mentioned that several thousands of miles of driving plastic-bodied cars has shown that the bodies do not become "unglued" and they are free of surface checking caused by road stone impacts or by vibration, torque or twist.

Resins used for reinforced chemical-resistant construction were discussed by the Atlas Mineral Products Co.

Data were given on three Plaskon polyester resins which have recently been added to the line of the Barrett Div., Allied Chemical & Dye Corp.

Shell Chemical Corp. reported on its new curing agent for epoxy resins. Data were also presented on the ability of epoxy laminates for chemical-resistant applications.

New hardeners developed for epoxy resins used for automotive and aircraft tooling were discussed by the Ciba Co. A new self-extinguishing expoxy resin has been developed by Ciba which is suitable for wet lay-up laminating.

A new room temperature cure tack-free resin and an outline for mulsification for binder resins were dealt with by Interchemical Corp.

In addition to fully describing the polyester line of Marco resins, Celanese Corp. of America reported that the entry of the company in the field of polyesters demonstrates the corporation's faith in the future of the reinforced plastics industry.

Another phase of the technical program of the organization was on the various molding techniques. C. A. McGill, engineer, Lone Star Boat Mfg. Co., in his paper on contact molding stated that this form is probably the most economical for building a reinforced plastic part. He stated that glass loadings of more than 30 per cent are difficult to reproduce by this method.

Bag molding was discussed by James S. Lunn, president, Lunn Laminates, Inc., and I. M. Scott, president, Winner Manufacturing Co. These speakers covered bag film, mold selection, molding operations, bleeding, and the advantages and disadvantages of the processes. They stated that bag molding is several times faster than contact molding but slower than rubber plunger or matched die molding. Molds for this method can be made of wood, plaster, cast phenolic, laminated plastic, or welded aluminum sheet.

It was reported during the meeting that in 1953 approximately 26 million lb of polyester resins were used by the industry and it is anticipated that in 1954 this will increase to 35 million lb. The present rate of increase is between 33 1/3 per cent and 40 per cent per year. A total of 3 billion lb of all types of plastics were used during 1953.

On the subject of reinforced plastics for tooling,

N. Mark Hastings, chief chemist, Rezolin, Inc., covered the reasons for using this type of tooling and explained some of the processes involved. Some of the advantages listed by Mr. Hastings for plastic tooling were as follows: reduction in weight, less material restrictions during national emergencies, simplicity in manufacture, flexibility in plant layout and utilization of manufacturing areas, ease of repair and alterations of plastic tools, shorter tool making time, fabrication of larger tools more practical, and intricate shapes and contours readily produced. According to Mr. Hastings, all these things add up to cost reduction as the end result.

There was great interest in the variety of subjects covered by the numerous technical papers. In addition to the excerpts taken from some of these papers and used in previous paragraphs, abstracts of three of the papers follow.

Cutting and Surfacing Reinforced Plastics

By R. T. Argy

Abrasive Engineer,
The Carborundum Co.

A BASIC manufacturing problem which is now being given serious attention by fabricators is how to machine and polish-grind reinforced plastics economically and efficiently. The existence of the glass reinforcing material, as the strengthening member, presents certain obstacles to the machining and grinding operations; obstacles which prevent the adoption of the same methods now used on conventional plastics.

A characteristic of glass reinforced plastics is their relatively low resistance to abrasion. From the standpoint of machining and grinding, however, this characteristic becomes a virtue. Most operations which can be performed with an abrasive tool can be done more economically thereby.

This may be illustrated by comparing the performance of a high speed steel circular saw with that of a glass fabric-reinforced resinoid grinding wheel in the cutting of glass-melamine electrical laminates. The saw, which costs $16 to $18 new, performs for about two hours, after which time it requires sharpening. It may be resharpened some 25 to 30 times, at $2 per sharpening. The abrasive wheel, on the other hand, costs only $2 initially. Its effective life is also about two hours, in which period of time it removes as much volume of material as the saw. (Data reported by Dr. Ralph Witt, Johns Hopkins University.)

In the sanding or grinding of many materials, including metals, woods, protective and decorative coatings, etc., the life of an abrasive product is limited by the loading of the cutting surface with chips of the abrasive material. Except for a few instances, where polyester resin surfaces are incompletely cured, loading is not a serious problem in the grinding of reinforced plastics.

Most of the dust is dry and does not smear over the abrasive. That which does accumulate is readily removed by a blast from an air hose.

In the glass reinforced-plastics industry, silicon carbide resinoid cut-off wheels are recommended for most major cutting, trimming and turning operations. The cut-off wheels that will prove most useful, however, are the glass-fiber reinforced and cotton fiber reinforced types. They may be used on either portable or bench mounted tools. These wheels may be used in the cutting of patterns having curved lines three in. in diameter. For less than three in. diameters, hand sawing is necessary.

Typical reinforced plastic fender die model used by Briggs.

Cast Aluminum Tooling for Large Reinforced Plastics Parts

By Jack Cuming

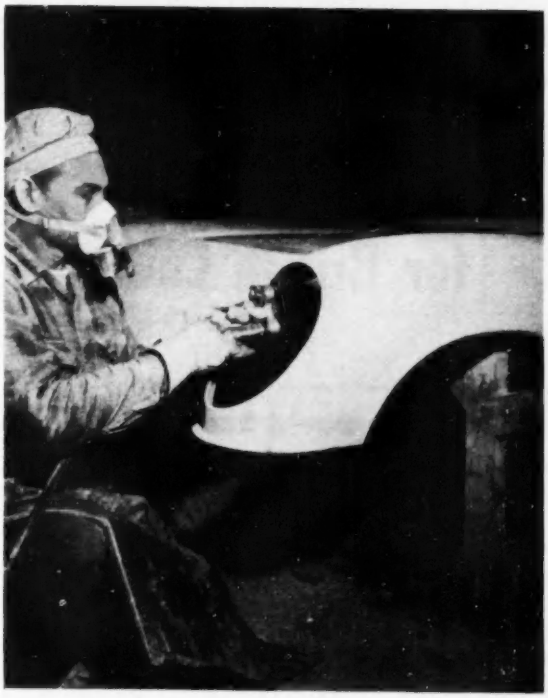
Vice-President and General Manager
Cuming & Co., Inc.

CAST aluminum molds have been widely used for successful tooling in the reinforced plastics industry since its inception. In recent years, cast aluminum molds have been found to be particularly suitable for large reinforced parts such as automobile bodies, aircraft wing sections, radomes, large tanks, etc.

The unique properties of cast aluminum molds which makes them ideal for these large parts are:

1. Low cost—approximately 25 per cent of the price of machined steel molds on compound shapes.

2. Easy machining—aluminum may be readily shaped and fitted by grinding and hand scraping.



Use is made of a Carborundum Port-A-Belt of 80 grit silicon carbide to trim edges of headlight opening in the Corvette. The air tool drives the belt at 9000 sfpm.

3. Good corrosion resistance.

4. Uniform heat—because of aluminum's high conductivity, hot spots are practically eliminated especially if a thick walled casting (two in.) is used.

5. Light weight—easier to handle and press-mount.

6. Readily welded—for ease in repairs or alterations.

7. Aluminum shrinkage — approaches the shrinkage of glass mat laminate much closer than steel allowing more accurate large sections.

Steel shrinkage per degree C. 12×10^{-6}
Alum. shrinkage per degree C. 23×10^{-6}
Mat. shrinkage per degree C. 25×10^{-6}

Large cast aluminum molds are made in four steps:

1. Pattern—made in plaster or wood with shrinkage allowance of approximately ⅛ in. per foot with a two in. wall thickness to allow for casting in a steel tube heating and cooling grid.

2. Casting—usually 4 per cent copper H16H silicon alloy which will give a relatively hard surface, good strength characteristics and easy machinability without galling.

3. Fitting—accurate plaster master block fitted to mold by blue blocking using heavy flexible safety grinders and hand scraping. Approximately ⅛ in. material removed in this operation. In matched molds, the female is finished first and the male spaced with clay or wax to give proper thickness.

4. Polishing—removal of all surface marks by buffing and fine grit grinding.

Models

The reaction to reinforced plastic models now in use by the Briggs Manufacturing Co. is favorable and encouraging. Again, the lighter weight and the ability to withstand hard usage makes them desirable.

To date, our work with reinforced plastic models has been mostly with duplications. The cost of a duplicate in models is far offset by the time saved in tooling up when more than one model is available.

Reinforced Plastic Tooling

By Fred Lyijynen

Supervisor, Experimental Plastics Div., Briggs Mfg. Co.

Dies

Several types of plastic dies—draw dies, form dies, flanging dies and others — have been produced by Briggs, and engineers find that each requires a different approach in order to obtain the desired results. To explain generally the process for developing these dies, we have selected as an example one of the most common types—the draw die. The process is a combination of hand lay-up and low pressure casting.

In the manufacture of draw dies it is practicable to work directly from models or from prototype panels. Assuming that we are to build a die to a wood model, we can, as required, add and open flanges on the model, establish ring lines and the like, and then cast our die directly against the model. The model to be used must

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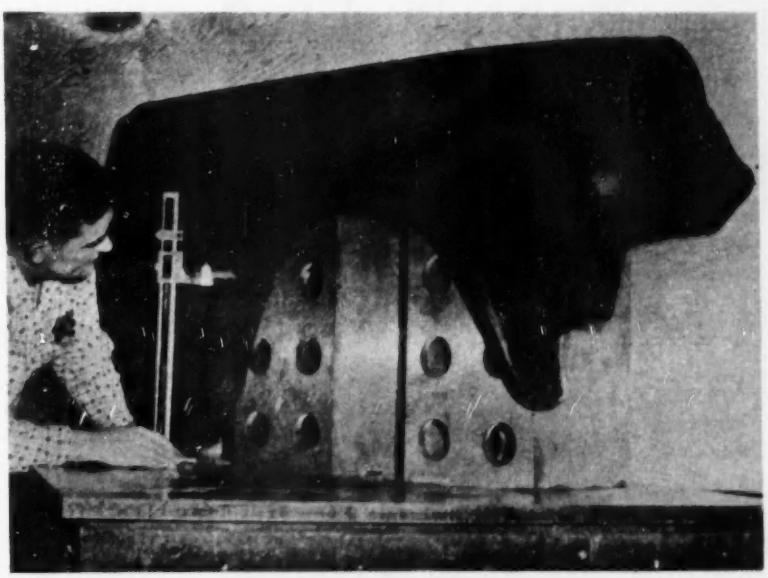
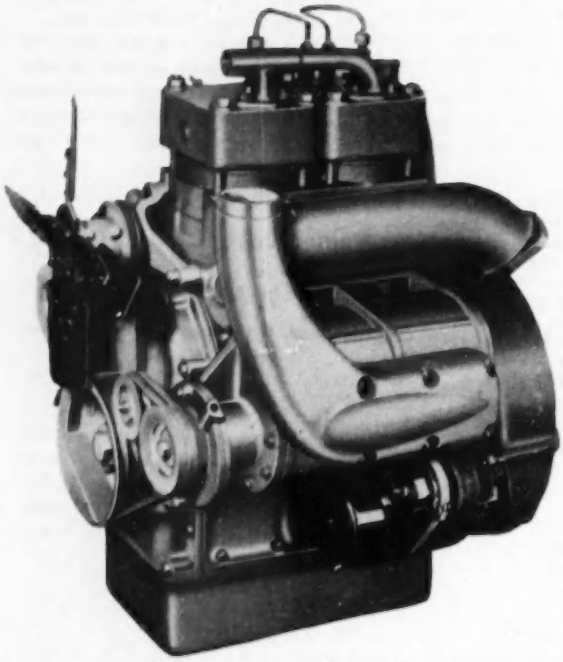
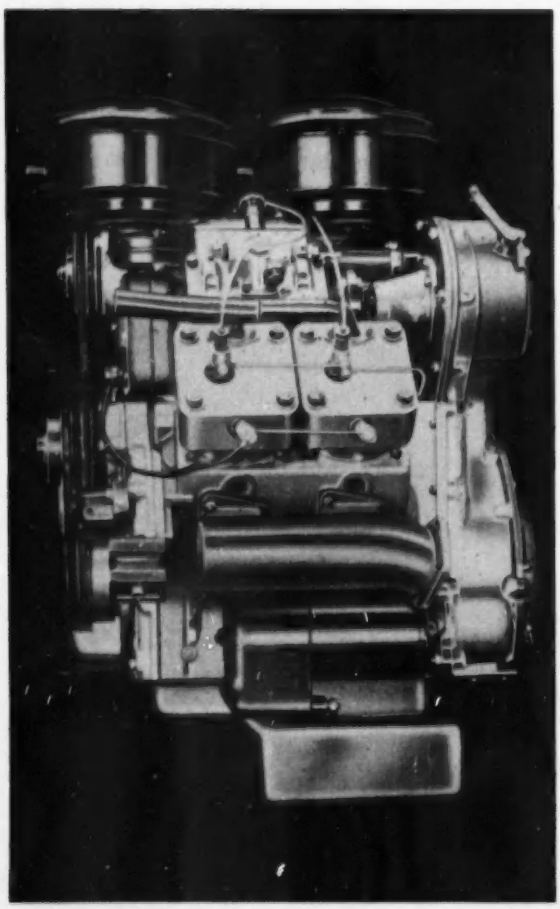


Removing a section of the cowl vent of the Corvette with a cotton fiber impregnated cutoff wheel. The wheel uses aluminum oxide of the 24 grit size. Conventional speeds are used.



Turner two-stroke Diesel designed for use in passenger cars.



The four-cylinder, V-type version of the two-stroke Diesel has an overall length of 29 in.

Two-Stroke Diesels for British Cars

By David Scott

INCREASING European interest in Diesels for automobiles and light vehicles has prompted Turner Manufacturing Co., Ltd., to produce a range of new Austrian two-stroke engines in England. These were designed and developed by the Anstalt für Verbrennungsmotoren under the direction of Prof. H. List with the help of Marshall Aid funds.

Features claimed for the two-cylinder unit now being built by Turner are simplicity of construction, high power-to-weight ratio, and small dimensions. These points are seen as reducing installation as well as production costs, since the low weight of the engine obviates strengthening of the chassis of a small car.

Output rating is 37½ hp at 2800 rpm, bore and stroke being 3.68 in. and 4.2 in. with a piston displacement of 85.5 cu in. Weight of bare engine is 340 lb, giving nine lb per hp. Engine block is of unit construction with light alloy crankcase heavily webbed for rigidity and noise reduction.

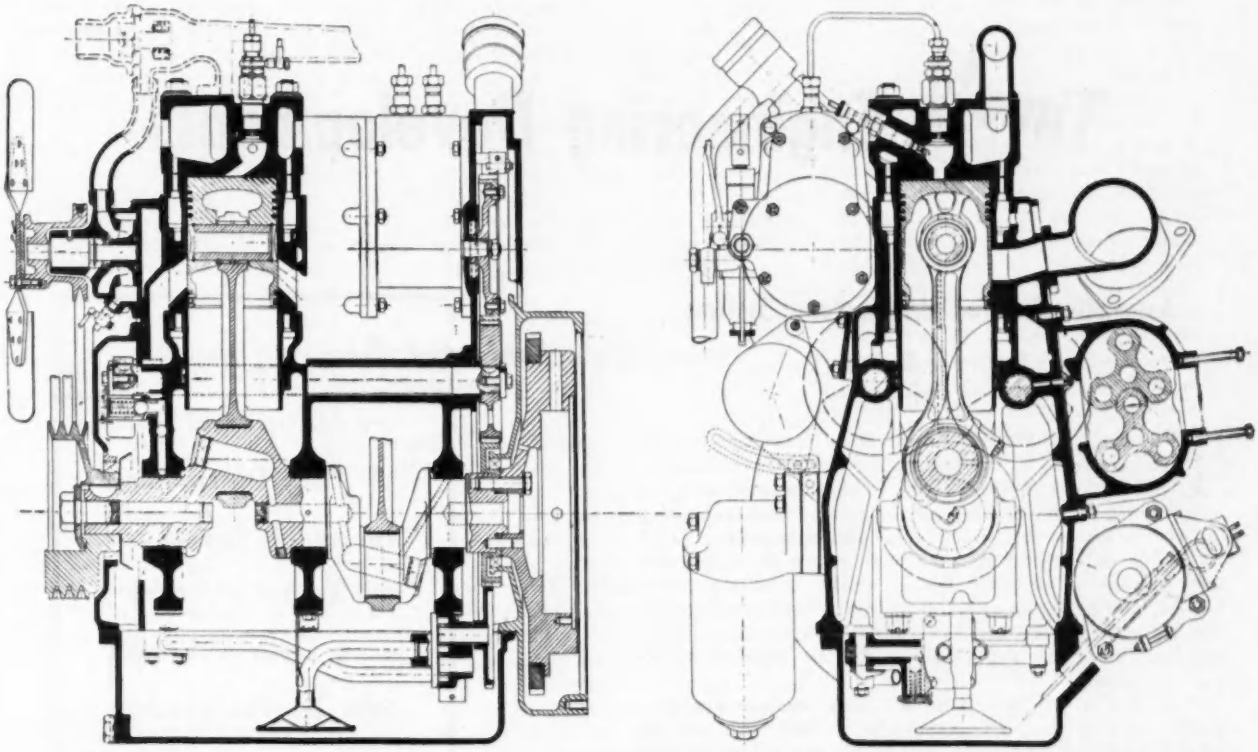
Loop scavenging is by a Roots-type blower driven by V-belts at 1.8 times engine speed. Multiple ports in the cast iron cylinder liners are machined to give directional stability to scavenging. Injectors are mounted vertically over the combustion chambers, the latter being of heat-resistant steel in two welded parts cast into the individual light-alloy cylinder heads. The flat-top pistons are of high silicon aluminum alloy. Compression ratio is 19 to 1.

A gear-type lubricating oil pump is driven from the crankshaft. For cold running before oil has thinned there is a ball-loaded relief valve on the input side of the filter which returns surplus oil directly to the crankcase.

Engine balance is effected by a pair of counterweighted longitudinal shafts geared to the injector pump drive and rotated in opposing directions in addition to weights on the flywheel and crankshaft pulley.

The two-cylinder Turner Diesel has undergone extensive road tests in a Vauxhall Wyvern, with fuel consumption of 45 mpg and smooth running claimed. Dimensions of this unit are: overall length 22.8 in.; height 28 in.; and width 19.7 in.

Only the two-cylinder engine is at present made in



Longitudinal and transverse sections of the Turner two-stroke, two-cylinder Diesel. Drawing, courtesy of The Oil Engine and Gas Turbine, England.

England, but it is expected that production will later be extended to include the three-, four- and six-cylinder models of the same design. The three-cylinder in-line unit is rated at 56 hp at 2800 rpm. The four- and six-cylinder engines, both V-form, develop 75 hp and 120 hp respectively at 2800 rpm. The last-mentioned has a piston displacement of 256 cu in., is 29 in. long, and weighs 720 lb.

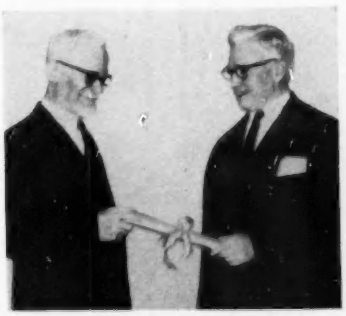
• • •

Sports Cars Are Analyzed at N. Y. S.A.E. Symposium

Sports car builders in Great Britain, who market a large part of their output in the U. S., believe American competition in this field will be good for business. This was the opinion given by John Benett, general manager of Hoffman Motor Co., importers in New York City, at a recent Metropolitan Section SAE symposium on "Sports Cars of Tomorrow."

Mr. Benett spoke at the dinner-meeting, at which P. M. Heldt, retired engineering editor of AUTOMOTIVE INDUSTRIES, was presented with a Life Membership in the SAE (see cut). Herb Shriner, whose sports car show (see p. 14 of this issue), was in progress in NYC at the time, also spoke.

At a special afternoon session, moderator Phillip H. Pretz, Ford Motor Co., defined a sports car for the purpose of the symposium as: "an open two-seater, with all equipment essential to highway driving; with acceleration and top speed performance a little above that of the current high price group of cars; a car which satisfies our desires for fun on the road, but does not necessarily fulfill our needs for transportation; a car which gives us the feeling of intimate control over a spirited steed, not a sedan chair remotely operated by instructions issued to slaves or servos."



P. M. Heldt, former engineering editor of Automotive Industries, is shown at the left receiving a SAE Life Membership scroll from Robert Cass, 1953 president.

Maurice Olley, Chevrolet Motor Div., compared suspensions of various sports cars, for comfort and roadability. Laurence Pomeroy, technical editor of "Motor" of London, noted the criteria for a sports car engine—low polar moment of inertia and high rate of air flow—and stated that the two-bank ohv engine with overhead camshafts and fuel injection will power tomorrow's sports cars. He mentioned steam power and said that work on this medium is being done in England.

Ellis J. Premo, Chevrolet Motor Div., outlined the use of reinforced plastics in sports cars. He indicated that plastic bodies were tested on production cars, particularly convertibles, before the Corvette was introduced.

Timely Engineering Developments

Automotive Electro-Hydraulic Power Systems

By George W. Lewis
Electric Auto-Lite Co.

Presented Here

are Abstracts of Some of the Outstanding Technical Papers of the Recent SAE Meeting in Detroit. Others Will Be Published in the Immediate Future by AUTOMOTIVE INDUSTRIES

THE advent of the self-starter many years ago may be considered to be the first major step toward relieving the motorist of some of the labor associated with the operation of an automobile. As a source of auxiliary power the electric system was rapidly developed to the point of great reliability and general acceptance. In recent years we have seen the advent of hydraulics as another auxiliary power system, and noted its rapid growth in power steering. We feel that this system, too, has a great future in the further development of the automobile to higher levels of safety and convenience.

Our belief is that these auxiliary power systems are compatible, and are mutually adaptable, so that each may do what it does best, and often combine to do a job better than either could do alone. In the following discussion we will emphasize the hydraulic aspects of auxiliary power.

On the basis of present experience, it can be assumed that hydraulic actuation in steering gears, window lifts, seat shifters, top lifts, transmission controls, and others, is quite satisfactory, as these are already in use. We might also assume that other functions could be satisfactorily performed by hydraulic power, such as: brake servos, windshield wipers, hydraulic motors, push-pull cylinders, and various other uses. Obviously, if we provide each of these functions with its own separate power source, the situation becomes complicated. In reality, we are approaching such a situation today.

The answer to this problem, in our opinion, lies in a well established system used in aircraft, heavy vehicles, and machinery, with many years of experience behind it. We refer to the closed center pressure system with an accumulator.

Fig. 1 shows the power lines laid along each side frame of the chassis. These are connected to the accumulator and the pump reservoir. The illustration shows the following lineup of hydraulic units: Hydraulic pump-electric generator, accumulator, hydraulic powered vibrator horns, turbine driven blower, power brake servo, windshield wiper, parking brake control, seat shifter and lifter, window lift, top lift for convertible, tank mounted fuel pump.

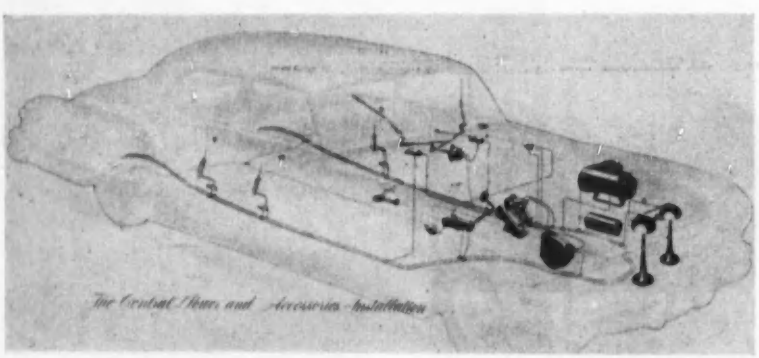


Fig. 1—Proposed passenger car electro-hydraulic system.

In the engine, where a separate drive for the hydraulic pump is not practical, the pump can be combined with the generator.

The hydraulic units must be entirely reliable, low in cost, and fully satisfy a large and increasingly critical motoring public.

There are several possible arrangements of auxiliary hydraulic systems. A very practical and time-tried arrangement consists of a constant displacement pump plus an unloading valve which directs the pump flow to the accumulator or the reservoir. Another arrangement consists of a variable displacement pump whose output flow varies inversely as the accumulator pressure.

In an auxiliary hydraulic power

system where the steady rate power consumption is moderate, electrically driven pumps are feasible. The electric motor is cut off when the accumulator is fully charged.

Electro-hydraulic devices, such as solenoid valves, indicators and pressure switches, will play an important part in controlling remotely located units. These devices, as well as the hydraulic units, should have a very low leakdown rate. A system where the accumulated hydraulic power leaks down on standing a short time, is likely to be unsatisfactory.

With the development of an auxiliary hydraulic power source and low cost actuators, both linear and rotary, we may expect to see the application of powered devices greatly extended. The availability of very good seals, oil resistant rubber-like materials, and low cost high precision manufacturing techniques, permits this.

Development of Blowdown Turbine for Turbo Compound Aircraft Engine

By F. J. Wiegand and W. R. Eichberg
Wright Aeronautical Div., Curtiss-Wright

A SECTIONED drawing of a power recovery turbine of the 18 cyl Wright Turbo Compound engine is shown in Fig. 1. The turbine is comprised of four basic systems—the power system consisting of the nozzle, wheel and shaft, the cooling system, including the cooling shields and impeller, the vibration damping system and the lubrication system. The parts comprising these systems are supported by two basic structural members. The first, the nozzle support sustains the stationary parts including the aircraft supplied exhaust shroud, while the second, the shaft support, sustains the rotating parts. Both the nozzle support and shaft support are clamped and indexed to an adapter bolted to the engine front supercharger housing.

Lubricating oil is supplied to the turbine unit from a drilled passage in the front supercharger housing. The oil is introduced to the turbine by an annulus at the lower end of the shaft support.

Sealing is accomplished by "O" rings installed in grooves on either side of the oil annulus. Oil flows across the lower bearing, through the void between the support and shaft, and then across the upper bearing. A seal from the "hot" section of the turbine is effected by a Graphitar seal ring and a stationary bellows seal. Oil scavenging is accomplished by gravity drain to the interior of the front supercharger housing.

The cooling system components of the turbine are emphasized in Fig. 1. Ram air, ducted from the front of the engine, is introduced into the turbine through an enclosing muff. An impeller, installed on the main shaft, provides the necessary pressure rise to force the air through holes at the base of each wheel bucket. The air is collected on the outlet side by a shield assembly and discharged into the exhaust outlet. Sealing between the exhaust gas and the cooling air is accomplished by a concentric groove labyrinth seal on the underside of the cooling air impeller and by a step type seal on the upper side of the wheel.

Recently, marginal turbine wheel hub cooling was encountered during high power operation at high altitude. In the particular installation, it was found that the pressure differential between the exhaust system and the cooling system increased at high altitude and disturbed the flow of air above the wheel. While this condition was improved somewhat by modifications to the flight hood, other changes were made to the cooling air system to increase the flow in the cooling system. A tangential outlet was provided to minimize the back pressure on the cooling impeller. To reduce exhaust gas leakage into the cooling air system a vent arrangement was incorporated at the step type seal on the upper side of the wheel and this exhaust gas was drawn off in an outlet concentric with the cooling air outlet to avoid dilution of the cooling air above the wheel. An inner heat shield was also provided to reduce the effect

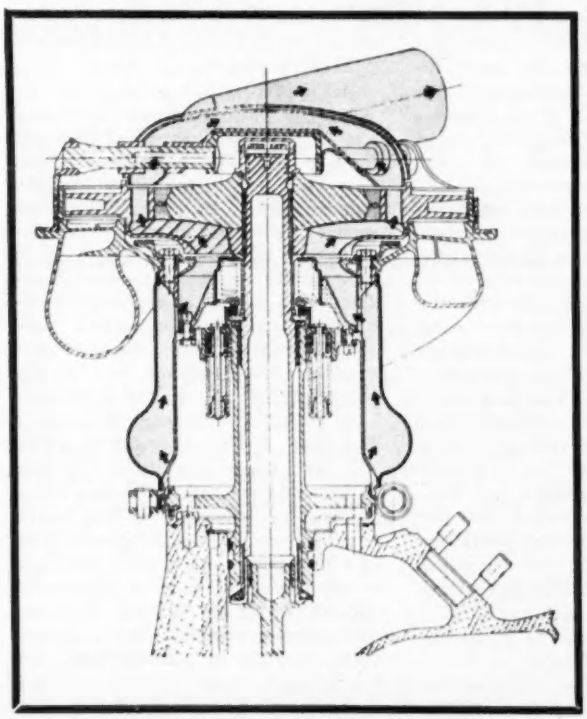
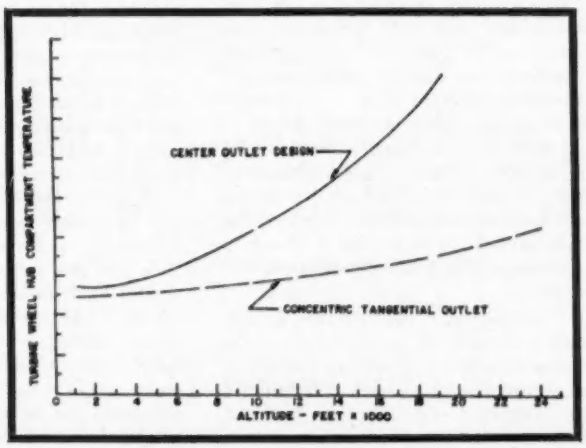


FIG. 1

FIG. 2



of radiant heat on the wheel hub. As shown in Fig. 2 this modification resulted in 100 per cent improvement in cooling at 18,000 ft altitude and permitted satisfactory operation under any power condition in the airplane.

The turbine shaft is sustained and aligned by two steel backed silver bearings mounted at either end of the shaft support. Axial thrust is absorbed through a steel backed silver spherical thrust washer at the lower end.

The shaft material is stainless steel for corrosion resistance and strength at the elevated operating temperature. The shaft bearing journals are nitrided for wear resistance and flats are provided on each journal to assure adequate oil flow at high speeds.

End float of the shaft is maintained within specific limits by selection of the proper offset thrust washer seating on the end of the upper journal. Radial grooves are provided across the thrust flange of the upper bearing to assure adequate oil flow under minimum end float conditions.

The cyclic power impulses inherent in a blow-down system tend to induce a whirling vibration in the rotating components. The vibratory forces at the resonant points, if undamped, would be transmitted to the turbine and turbine support structure, necessitating a very heavy rigid construction. Since there are a number of exciting frequencies generated by both the engine and the turbine gas forces, it was necessary to develop a damping system which would prove effective for all orders and have a reasonable weight. This was done by designing the turbine support structure as a spring, which is a pedestal on a spring diaphragm permitting the turbine wheel within the limitations of the spring, to move slightly in all radial directions. The upper end of the pedestal was equipped with a plate type friction damper in which half the plates were fixed to the nozzle support and half the plates were fixed to the pedestal. Loading was provided between the plates by eight springs compressed to a predetermined load. Since relative motion is allowed by this means and damping is present, vibratory gas forces coming through the wheel or engine excited forces transmitted through the case cannot excite resonant vibration over the entire operating range of the engine.

The materials incorporated in the turbine wheel were selected for optimum corrosion resistance and strength at elevated temperatures. The buckets are Haynes Stellite No. 31, which not only has excellent corrosion resistance, but also a low creep rate at the operating stress and temperature level. The buckets are welded to the rotor disk since this method of attachment provided the lightest design.

Inconel X was initially selected for the disk material because of its high temperature properties. Testing has shown, however, that the operating temperature level of the disk is such that less strategic alloys may be employed. Evaluation of Timken 17-22A material with an oxidation resistant coating is in progress.

The wheel assembly is splined to the turbine shaft with a sliding fit when cold. Primary torque transmission, however, is accomplished through a friction joint, since the wheel is clamped through a spool spacer against the end of the upper shaft journal. Clamping magnitude is determined by measuring and controlling shaft stretch within predetermined limits.

To isolate the torsional vibrations inherent in the power recovery system from those inherent in the basic engine, a fluid coupling is provided in the drive system. This coupling prevents any build-up of forces in the drive system excited by torsional vibration and permits the use of a lightweight drive system. To avoid complications in the lubricating system, engine oil is used in this coupling. Early in the service operations it was evident that in spite of the high velocity circulation of oil within the fluid coupling the quantity of oil flow through the coupling was insufficient to flush completely the low velocity discharge area where sludge would accumulate. This locked the two elements of the fluid coupling which permitted torsional excitation of the drive and adversely affected its durability. Increasing the oil flow and improving the cleaning of the airplane oil system improved the service life but did not completely eliminate the accumulation of the sludge. As further insurance against sludge accumulation, several configurations were developed which by mechanical means prevented formation of sludge in the low velocity area. The most desirable configuration, however, was the vortex flushed fluid coupling which is currently incorporated in the engine. This coupling utilizes the high velocity stream of oil circulating within the coupling to flush the area of potential sludge accumulation.

Free Pistons and Gas Turbine Engines Compounded

By A. L. London

Professor of Mechanical Engineering,
Stanford University

It is believed that the French and German developments have already convincingly demonstrated the commercial feasibility of the compressor version of the free-piston engine concept. In this application, however, the engine section operates at conventional two-stroke Diesel conditions and no unusual combustion and heat transfer problems are involved. In contrast, the prime mover version operates at high supercharge with the associated higher combustion rates per unit volume and higher charge density conditions, all accentuating the heat transfer and ring and lubrication problems. Nevertheless, the moderate commercial success already achieved by the SIGMA model GS-34, the promising preliminary test performance of the Cooper-Bessemer unit and the demonstrated durability of the Baldwin-Lima-Hamilton model DL unit, all suggest that the prime mover system is rapidly becoming a proven unit of machinery. With the entry of General Motors and other organizations into the development, accelerated progress on this revolutionary engine concept in this country can be reasonably anticipated.

All the free-piston prime mover applications which have been attempted are in the power range of 500-1500 hp per unit, and no serious efforts have been devoted to units in the 100-300 hp range. In view of the much greater ease and lower cost of development of a smaller unit it seems paradoxical that this is the case. However, both the Baldwin-Lima-Hamilton and SIGMA developments were Navy sponsored, and navies in general are more concerned with the development of larger marine propulsion units. In the case of Cooper-Bessemer, the development incentive was, apparently, the threat of competition of a 5000 hp gas turbine plant for gas line pumping, so that again circumstances forced the development of a high power rating unit. In view of these circumstances a reasonable expectation for the future is a greater effort devoted to the lower powered units, possibly to compete with the heavy truck engine and the medium speed Diesels extensively employed in

heavy duty earth moving equipment.

In view of the commercial success already achieved in Europe with free-piston compressors, it may be that the conservatism towards this application encountered in this country will eventually be overcome, either through license agreements or through domestic developments. From a technical point of view the compressor set development possesses the attractive feature of providing a free-piston education free of the difficult heat transfer and combustion problems of the prime mover application. Moreover, because of the relative ease of the development, commercial production could be achieved in one or two years of effort.

The foregoing opinions are offered with the full realization that the patent situation has not been considered. All that will be noted here on this subject is that over 50 U. S. patents have been issued to the SIGMA-Pescara organization, about 16 to Junkers, and about six to the Sulzer organization of Switzerland.

Performance with Chrysler PowerFlite

By W. R. Rodger and A. J. Syrovy
Chrysler Corp.

OUR goal was high torque with low engine stall and overrun speed. That this goal was attained satisfactorily can be seen in Figs. 1 through 4. Fig. 1 shows the performance of the 12½ in. converter with constant input torque. Fig. 2 shows the performance behind the Chrysler Fire-Power V-8 engine in a Chrysler New Yorker automobile. Note on Fig. 1 the torque ratio of 2.6 to 1 at stall, and on Fig. 2 the relatively low stall speed of 1490 rpm. Figs. 3 and 4 are comparable performance curves for the 11¾ in. unit, again with constant input torque, and then in a Dodge V-8 automobile. The performance characteristics of these converters are based on many considerations and we believe they represent extremely fine compromises to fit so many models in such a satisfactory manner.

New Developments in Turbocharging

By Rudolph Birmann
DeLaval Steam Turbine Co.

COMPETITION has forced every manufacturer of medium- and large-sized four-stroke Diesel engines to adopt turbosupercharging. A trend in the same direction has just recently begun in the field of small engines.

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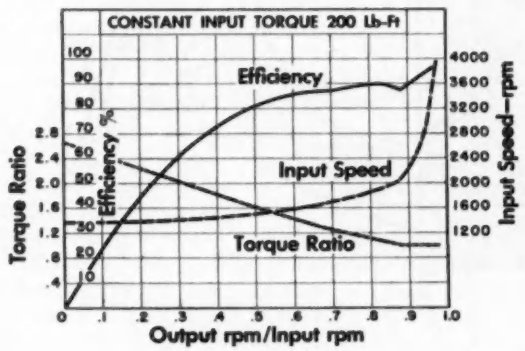


FIG. 1

Performance—12½-in. torque converter.

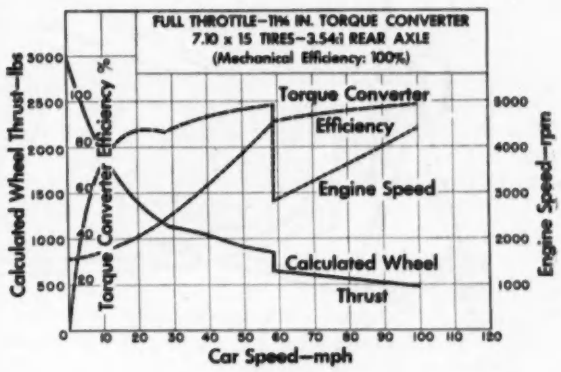


FIG. 2

Performance—Chrysler V-8 with PowerFlite

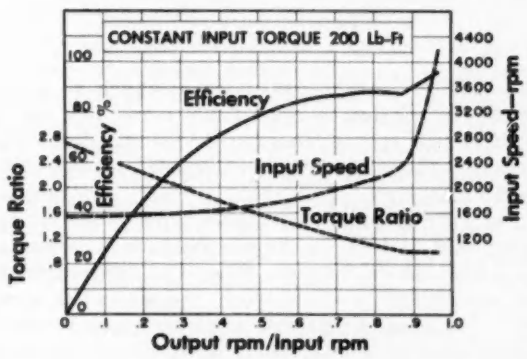


FIG. 3

Performance—11¾ in. torque converter.

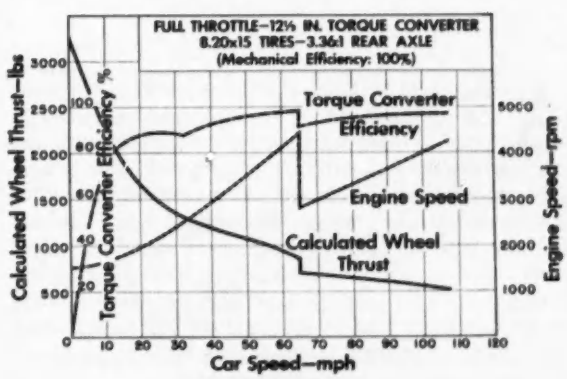
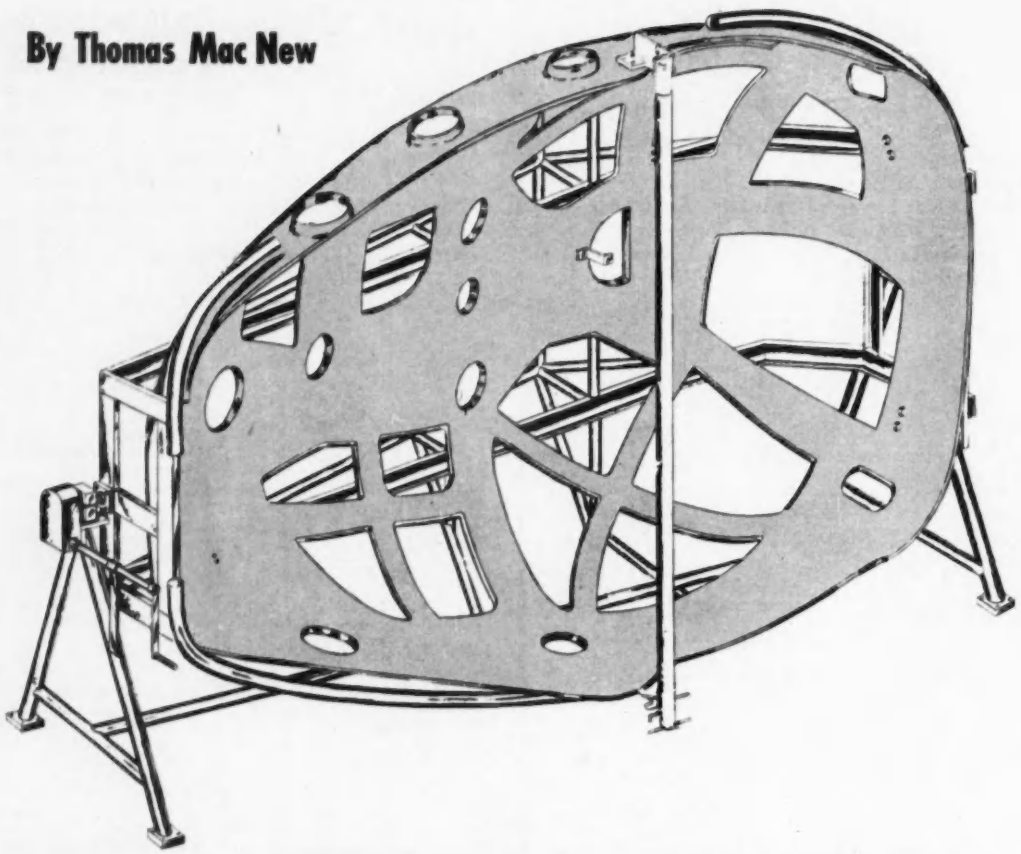


FIG. 4

Performance—Dodge V-8 with PowerFlite

Laminated Glass Fiber Plastic Tooling Cuts Lead Time Up To 50 Per Cent

By Thomas Mac New

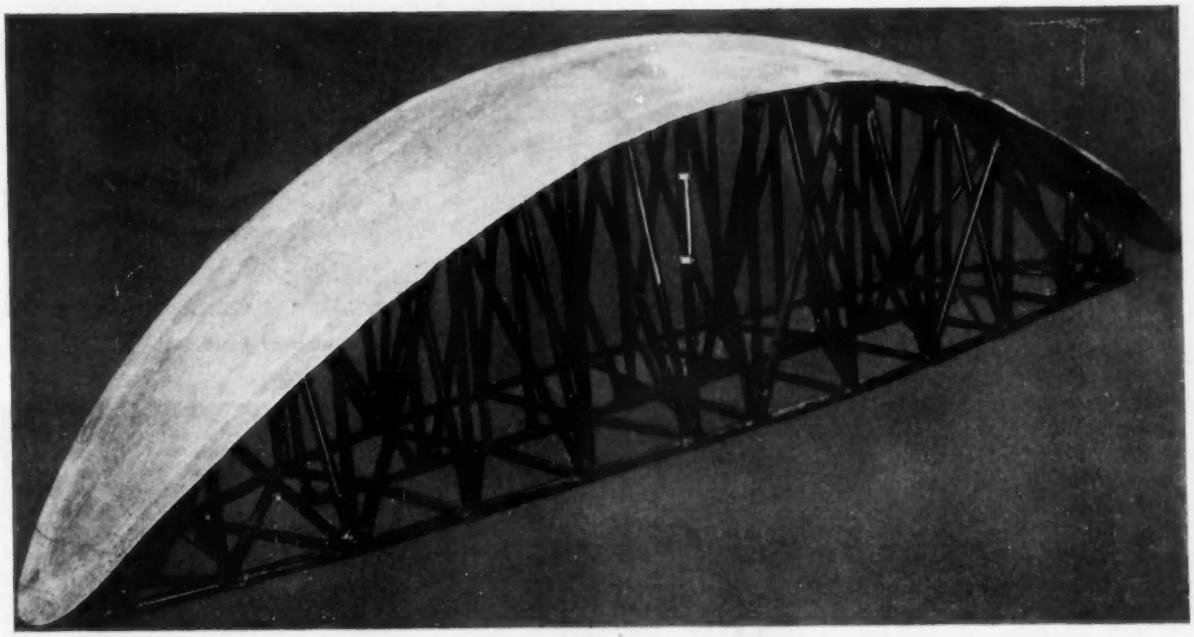


Nose assembly drill jig for a helicopter. The laminated glass fiber plastic jig was made over a Keller model and is ¼ in. thick; total cost including the steel trunnion was approximately $3700.

A GREAT deal of laminated glass fiber plastic tooling in the form of jigs, fixtures, and dies is being utilized by Goodyear Aircraft Corp. for the manufacture of aircraft components, and is also being supplied by the company to makers of both automobile and aircraft parts. The company is tooled up for any type of reinforced plastic production—from hand lay-up to matched metal dies. From its own experience Goodyear reports that it has realized savings of up to 60 per cent in cost and 50 per cent in lead time over conventional methods with some of its plastic tooling utilized for aircraft assemblies.

Some of the reinforced plastic tooling made for its own and exterior consumption includes apply trim templates, routing jigs, checking fixtures, drill jigs, assembly drill jigs, spot welding fixtures, stretch form dies, contour fixtures, forming jigs, master patterns, and spotting fixtures.

For current production, three types of resins are being used by GAC in the manufacture of laminated glass fiber plastic tooling. When tool temperature is not expected to go above 160 F, the air curing epoxy resins are used. Otherwise, a regular grade polyester is combined with glass fiber for temperatures up to 240 F, and a heat resistant type polyester is utilized for temperatures as high as 350 F. At times, the com-



Forming fixture of reinforced plastic used for an aircraft component.

pany has used phenolics when the application—such as for drop hammer dies—runs in the high heat range.

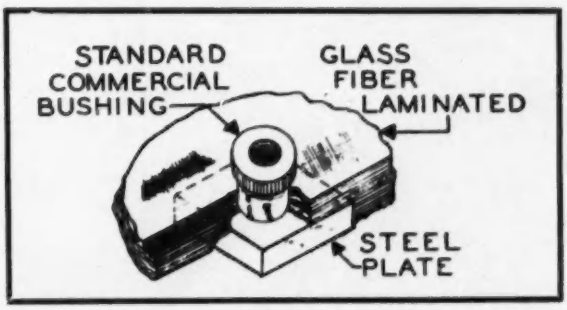
Heat cleaned woven glass is used for most tooling with glass fiber mats or rovings used for reinforcements. In most tooling applications the resin content is from 40 to 50 per cent with glass making up the difference. When pads are required, the resin content is reduced to 30 per cent.

When making up tooling with the air-curing epoxy resins, GAC uses the hand lay-up method. The model, either of plaster, metal, or wood, is coated with a fine grade of Simoniz wax so that the resin will not adhere to the model; this facilitates removal of the finished product. Next the epoxy surface coat resin is spread over the model by means of a brush. When the resin sets to a tacky consistency, the glass fiber cloth is applied. This process is continued until the desired thickness is attained. As noted in the illustrations of the aircraft windshield, the critical checking surface is usually made a cream color with the background black. The tooling remains on the model until finally cured. Surface finishing the epoxy-glass tool is usually performed by hand scraping with conventional woodworking plane blades. A fine grade of emery cloth is used for final finishing. All epoxy-glass tools are given a post cure in an oven at 140 F to eliminate any internal stresses.

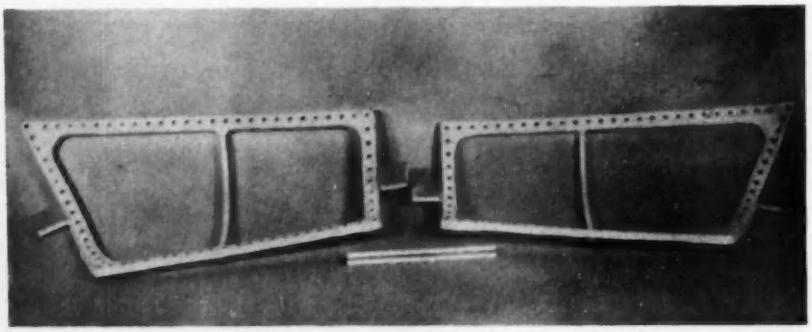
Vacuum bag forming is generally used by GAC when making tools of regular polyester resins. Glass fiber fabric is cut to shape and placed over the form in layers until the desired thickness is reached. The resin can be applied to the glass cloth, either before or after it is placed in the mold, by several different means—sprayed, brushed, or wiped on with a spatula. The materials are then enclosed in a plastic film bag which is thoroughly sealed, except for a hose fitting. Air is then drawn out of the bag in order to collapse it against the tooling lay-up. This presses the laminate against the mold and removes excess resin and air bubbles through porous "breathing strips" placed around the periphery of the part.

With the blanket or bag still in place, the part is heat cured—the length of time required for this operation being primarily dependent on the size, shape, and maximum permissible temperature of the material. When cooled, the bag is taken off and the laminated plastic is separated from the mold. Where trimming is necessary, abrasive disk sanders and cutoff tools are preferred by GAC.

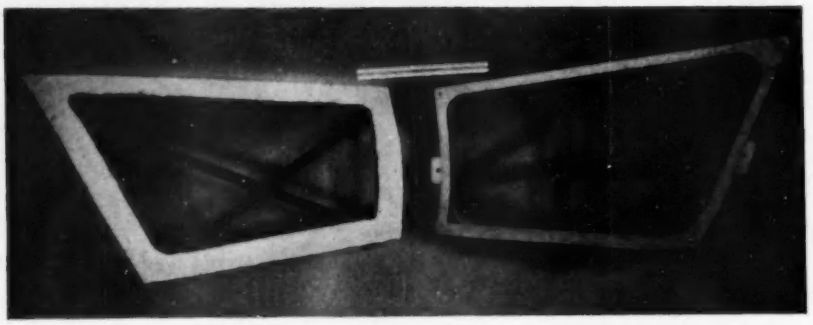
In the process for making forming molds for bonded assemblies, Goodyear uses the heat-resistant type of polyester resins. These are designed for curing temperatures of 325 F. In order to facilitate handling and to provide torsional stiffness to the mold, the lamination is placed in a steel "torque box." According to GAC engineers, the mold should be no thicker than



Typical mounting of a drill bushing in reinforced plastic drill jigs. Thickness of the plastic laminate would be about ⅜ in.



Reinforced plastic drill jig for an aircraft windshield.



Checking fixtures for an aircraft windshield. The fixture is made up of epoxy resins and glass cloth. White surfaces depict the critical portion of the fixture.

⅜ to ½ in. so as to provide suitable heat transmission.

Normally, the glass fiber laminate female mold is built up over plaster and then cured at 270 F, and post-cured at 350 F. This causes a breakdown of the plaster surface and facilitates the removal of the plastic mold. Before curing the mold, however, glass fiber angles are molded in for attachment to the steel torque box. It is recommended that a certain minimum gap clearance be maintained between the mold and the box for proper air circulation.

Although machining is not usually necessary in the manufacture of reinforced plastic tooling, Goodyear recommends the use of carbide tools with kerosene as a coolant when machining is required. Of course the big problem is when the cutting tools contact the glass fiber laminate. Also, a method has been devised by GAC to keep the glass rovings off of the working portion of the machine tool by using vacuum cleaners for picking up dust. GAC does not use a coolant pump but adds coolant manually as required.

Reinforced plastic tooling can be milled on regular machines but the spindle speed should be somewhat higher than conventional practice. When turning the material in a lathe, the same practice should prevail as that used to machine brass. Both of these operations should be done with carbide tipped cutting tools.

Standard drills and taps can be used for their respective operations with the speed at a normal rate. Since taps wear rather rapidly when used for reinforced

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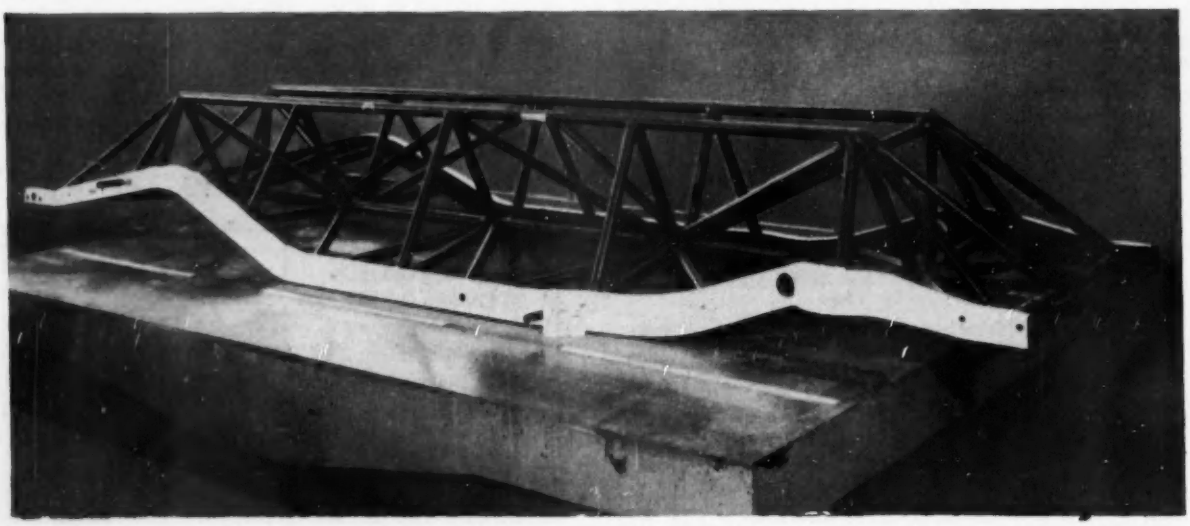
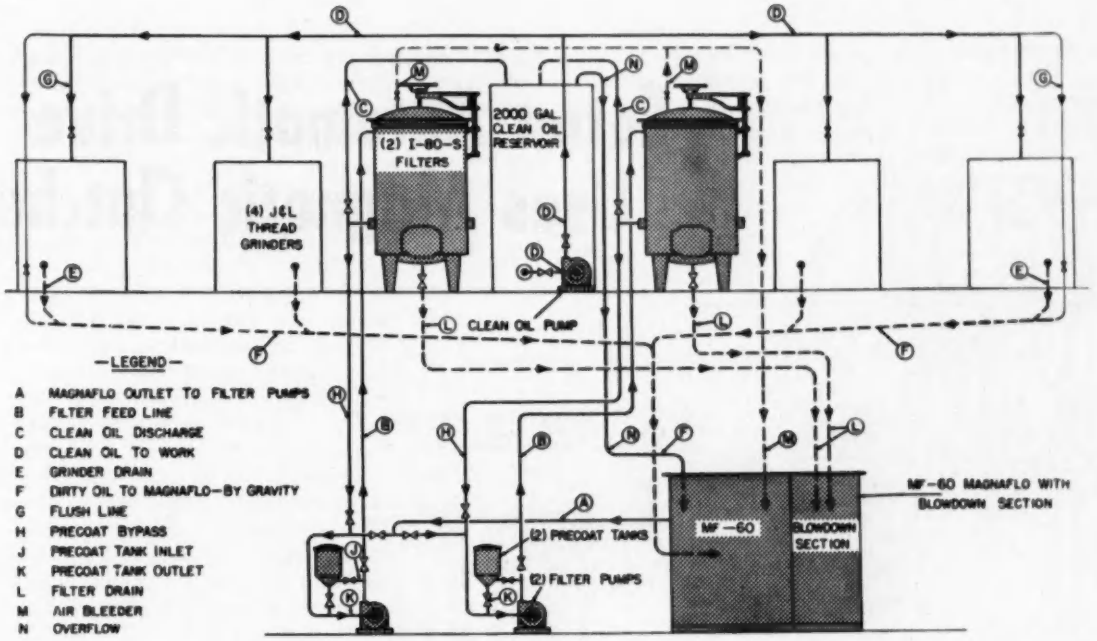


Made up of Ren-ite resins, laminated with glass fiber, this checking fixture is for passenger car frames. Its total weight is 108 lb.



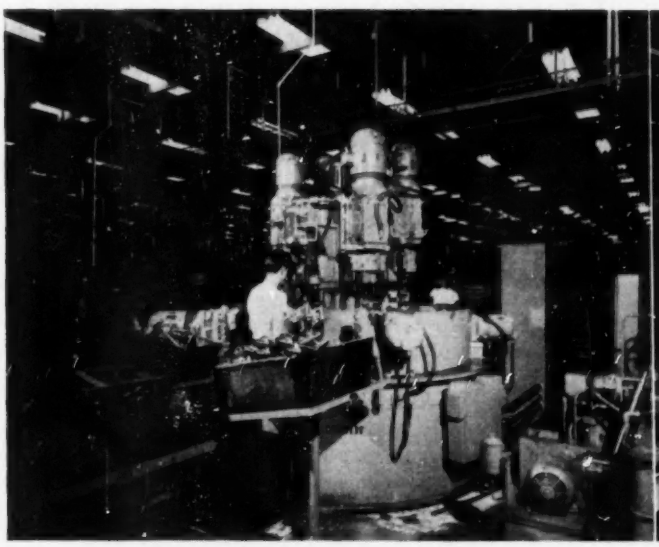
FILTERING CUTTING OIL AT AUTO-LITE PLANT

In laying out a new division for the production of electric windshield wipers, the Electric Auto-Lite Co. found it advisable to install a complete filtration system for their grinders in order to overcome excess contamination in the cutting oil and eliminate high cost of discarding this oil. Grinders are used to thread armature shafts for wiper motors.

Arrangement of the equipment used in the Auto-Lite production system is shown above. The filtration system consists of two U. S. Hoffman model 1-80-S pressure filters with a flow rate of 140 gpm each, one Hoffman Magnaflo model 60, with a magnetic type filter and flow rate of 100 gpm, and one 2000-gallon oil reservoir. It is designed to serve four Jones and Lamson thread grinders. The system oil capacity of 4780 gallons is a little larger than needed at present but will become necessary when two more J & L grinders are added in the future.

Correction

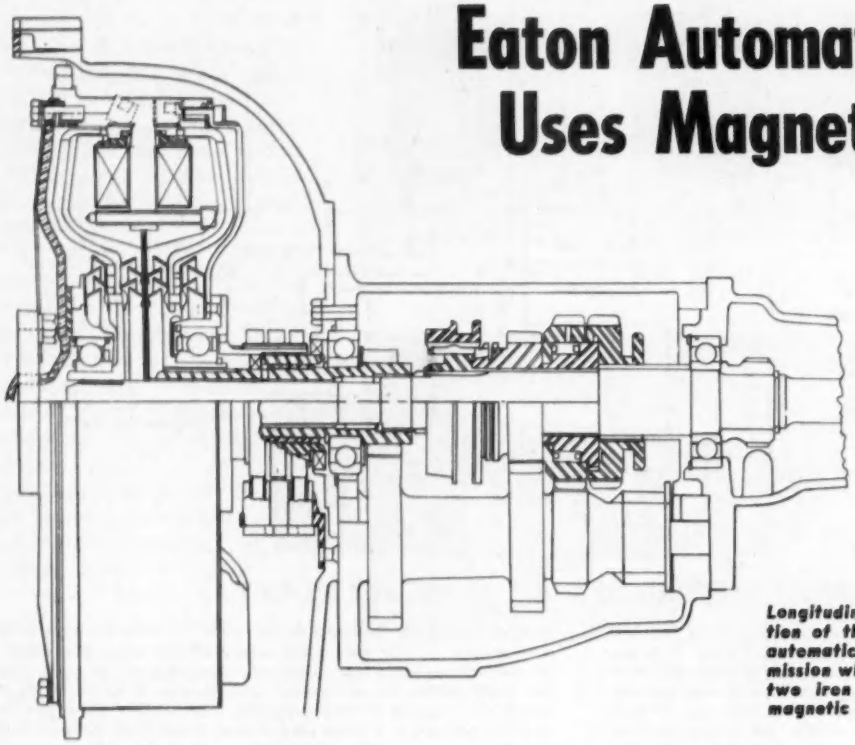
Attention is called to the fact that captions were transposed for these photographs appearing in the article, "Wide Application of Transfer Machines at Chrysler's Automatic Transmission Plant," published in the Feb. 1, 1954, issue of AUTOMOTIVE INDUSTRIES, page 66. Correct captions are reproduced below.



Kingsbury multi-head drilling machine set up for an automatic indexing cycle of drilling and tapping the mounting flange, as well as drilling oil holes in the reaction shaft.

Reaction shafts are machined three at a time in this Bullard Man-Au-Trol horizontal lathe which performs most of the major steps in an extremely fast cycle of automatic events.

Eaton Automatic Drive Uses Magnetic Clutches



Longitudinal section of the Eaton automatic transmission which uses two iron powder magnetic clutches.

An entirely different automatic transmission, made feasible by the use of magnetic clutches has recently been developed for the passenger car field by the Eaton Manufacturing Co. This long-time maker of parts for the automotive industries has installed one of the transmissions in a Ford four-door sedan for thorough testing by its own research people and the research departments of the passenger car producers.

Eaton's engineers state that its magnetic clutches have inherent characteristics which make it possible to design simple, inexpensive gear boxes for use in automatic transmissions. These clutches are as smooth in engagement as hydraulic couplings, yet are capable of being "locked up" so that no power is lost due to slippage. Their release is instantaneous and complete, as there is no viscous friction or drag when de-energized. In transmission designs, it is quite practical to use a sliding-spline type of shift, a self-energizing wrap around band, or any similar simple method of changing ratios. No matter how rough a shifting mechanism is used, the shift with the magnetic clutch is barely noticeable to the driver. They are capable of being slipped for a considerable time without wear so that they can be used to pull the engine speed down to synchronize shift speeds without damage to the clutches. Earlier clutches of this general type developed by Eaton were described in AUTOMOTIVE INDUSTRIES, Dec. 15, 1950.

Although a variety of transmissions are possible because of this clutch development, this article deals primarily with the unit used in the Ford sedan. Basically, the drive consists of a three-speed synchromesh transmission arranged for power shifting and two electrically-actuated magnetic-powder clutches. The low speed gear is provided with an over-running clutch. Both of the magnetic clutches are in front of the transmission, and are contained in a housing similar in size and shape to a hydraulic torque converter housing.

The shifting quadrant has five selection stations—R, N, D2, D3, and L. In the prescribed order, R and N are of course reverse and neutral. In D2 the unit deviates from the norm, for in this station it shifts from first to direct and in D3 it shifts through all three—first, second, and direct. In the L position it shifts between first and second.

Additional units necessary to the operation of this new transmission are a variable resistor switch, a governor, and a relay for clutch current. The resistor switch, or caterpillar network as it is called by Eaton, contains five fixed resistances from 1 ohm to 0.2 ohms. Also, a neutral switch is utilized so that the car cannot be started in gear.

The magnetic clutches used in conjunction with the three-speed transmission are of Eaton's patented design and use magnetic powder mixed with a dry lubricant. Iron makes up two-thirds the powder's volume and slightly more than 90 per cent of its weight. Total volume and weight of the mixture are 75 cc and 11 oz respectively.

Each clutch consists of a driving member or rotating electromagnet, which contains the field coil in a steel housing, and a driven member which is designed in the form of a drum. The coil is made up of number 13 enameled copper wire. There is a fixed air gap between each side of the drum flange and the field coil unit. In operation, this air gap is filled with the magnetic powder and lubricant mixture.

For engagement, electric current is taken through brushes to collector rings and then to the field coil. This sets up a magnetic flux in the driven member, and also magnetizes the iron powder and driven drum, which causes the entire assembly to lock up as a unit. The magnetic powder is drawn into the air gap where it is "frozen" in direct proportion to the magnetizing current applied. Approximately 18 watts are necessary under average driving conditions for complete lockup; less than that will permit the clutch to slip. With the engine running, but with no current being fed to the field coil, the iron powder is thrown into a reservoir on the side of the drum by centrifugal force. A series of baffles and laybrinth seals prevents the powder from getting in bearing surfaces.

For the description of the transmission's operation, the two magnetic clutches will be referred to as the high and low clutch.

With the selector lever in the D3 position and with the car at a standstill neither clutch is engaged, therefore, there is no creep even though first gear is always in mesh as the clutches have a clean frictionless release. By depressing the accelerator pedal, current is fed to the low clutch. The amount of current is dependent on the position of the accelerator pedal and on engine speed. If the engine speed is extremely low, there is an automatic drop in voltage as signaled by the voltage regulator. This then causes the clutch to slip and lets the engine come up to speed when making wide open throttle starts and as soon as the vehicle is under way, the low clutch locks up. Under actual driving conditions, this entire operation takes only a couple of seconds. The low speed clutch drives the transmission counter-shaft through a quill rotating around the high speed shaft. Power then goes through the first speed gear overrunning clutch member to a shifter flange arrangement which is splined to the main shaft.

When the governor is satisfied (automatically determined by car speed and accelerator pedal position), electrical current is fed to the high clutch and then interrupted to the low clutch so that there is continuous, uninterrupted torque since the high clutch drives direct through the transmission's main shaft. The high clutch then pulls the engine down until its speed synchronizes with the second speed shifter which is spring loaded and waiting to engage second.

As soon as synchronous speed is reached, the sliding spline sleeve engages second gear. Instantly the high clutch is de-energized and the low clutch is energized to complete the ratio change into second gear. First and second gears are always in mesh.

After proper speed conditions that satisfy the gov-

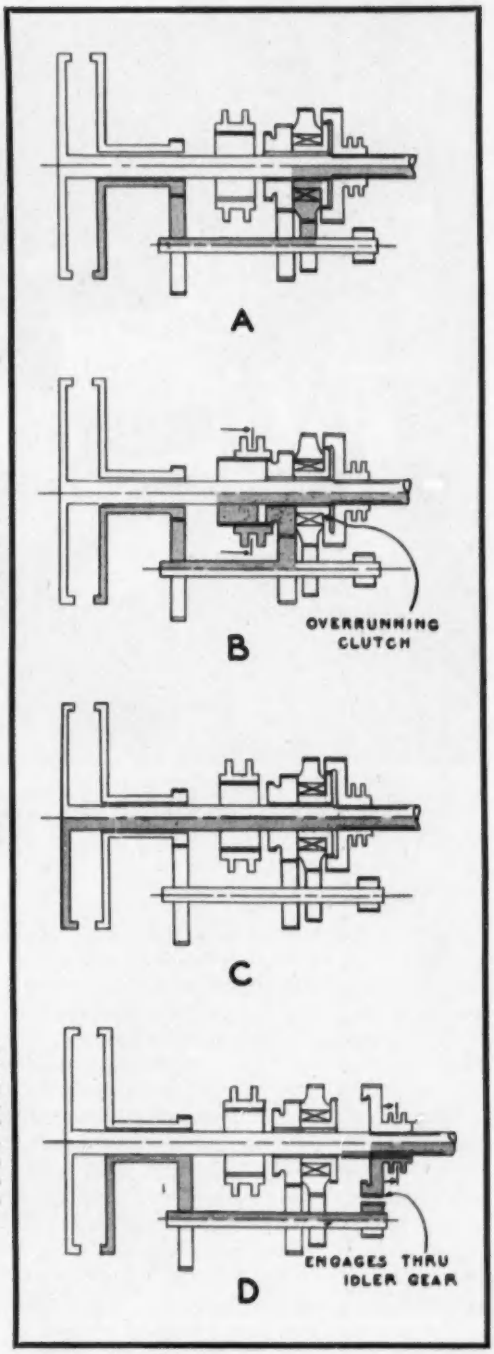
(Turn to page 76, please)

For first gear, power is taken through the low magnetic clutch to the countershaft, through the overrunning clutch member to the shifter flange and the mainshaft.

For second, power is delivered through the low clutch to the countershaft to the second speed gear and then to the mainshaft.

In direct drive, the high clutch drives straight through.

Power for reverse is through the low clutch to the countershaft, to the reverse idler and to the external gear on the shifter flange which is splined to the mainshaft.



Power flow diagrams of the automatic transmission.

Design and Production of

Experience with this 15,000 ton forging press has supplied much of the knowledge available on heavy aircraft forging techniques.

As the Air Force Heavy Press Program advances, the forging techniques used for the production of large aluminum parts grows from experiment into operating practice. One of the country's pioneer installations in the development of heavy press forging techniques is the 15,000-ton forging press at Alcoa's Cleveland (Ohio) Works.

In the past two years, a store of knowledge has been built up on the operation of the 15,000-ton Schloemann press. Approximately 50 different parts have been produced on the press involving more than five million lb of metal forged. Experience has been gained in sinking the dies to produce these forgings. These advances offer a guide to future practice in heavy press forging operations.

The product from heavy forging presses, of course, will be used mainly by the aircraft industry. Since aircraft manufacturing is a very dynamic industry, the obsolescence rate is exceedingly high, and radically new ideas in design are the order of the day. Problem of the press operator, in serving such an industry will be to maintain a sufficient degree of flexibility in his operations so that current progress can be translated into practical and economical engineering contributions before service requirements and design changes kill the job.

Most of Alcoa's experience up until the past two years in production of light alloy airframe forgings has been on hammers, from very small units of 2000 or 3000 lb up to hammers of 35,000 and 40,000 lb capacity. In addition, many small and medium sized forgings have been produced on mechanical forging presses up to 2500 tons capacity and on hydraulic presses of from 1500 to 3000 tons.

All the recommended design proportions and related engineering standards as set forth in Alcoa's design manual have been established primarily on the basis of hammer fabrication. Since March of 1952 when the 15,000 ton hydraulic press went into production, over 50 sets of new press dies have been constructed and quite a number of large hammer dies have been adapted for press production. In all, more than 5 million lb of metal has been processed, in the course of which a considerable amount of valuable data and experience has been accumulated. It is largely on the basis of this data and experience that this article has been prepared.

It is not possible at this time to present design factors and standards which can be generally applied to press forging practice. Nevertheless, there are certain clear indications which can be brought out and which should be of definite assistance to those responsible

By A. E. Favre, Chief Production Engineer
Aluminum Co. of America

Light Alloy Forgings by Heavy Press Operations

for the engineering design of large light alloy press forgings.

Surface quality has been greatly improved as evidenced by greater smoothnes and freedom from laps, folds and other defects which have to be chipped out between hammer operations or ground out and polished in final inspection.

Dimensional uniformity from forging to forging has been better than expected. Dies are designed so that they come together and although they sometimes do not do so in hydraulic press operations, a high degree of uniformity in total pressure and unit pressure does exist from forging to forging so that if temperatures, dwell and lubrication are accurately controlled, the resultant dimensional uniformity should be good.

Draft angles which are standard at seven deg and are rarely less than five deg in hammer forging practice can easily be reduced to five deg, three deg, or even less, in press forging. There are a number of reasons for this, the most important being the ability to incorporate knockouts in the dies, which is not practical in hammer dies.

Thinner webs and ribs seem to be definitely in the cards for forgings manufactured on presses, although perhaps not so thin as the aircraft designer could use and would like. Reduced draft angles are partially responsible for such improvement. Superior lubrication, higher die temperatures (not practical with hammer dies), and "dwell," under pressure are other important factors contributing to this result.

Experience with die life at Alcoa during the past two years on the 15,000 ton press is outstanding. On the other hand, this may not be quite representative of what may be expected in the future. There have been no major die failures, although a large hard plate holder was broken as a result of an operating error. Since few jobs have been produced in any substantial volume, the die mortality record cannot be taken as an index of future experience. Operations at Cleveland have been meticulous about setups, which fact has been reflected in the costs. If the setup looks

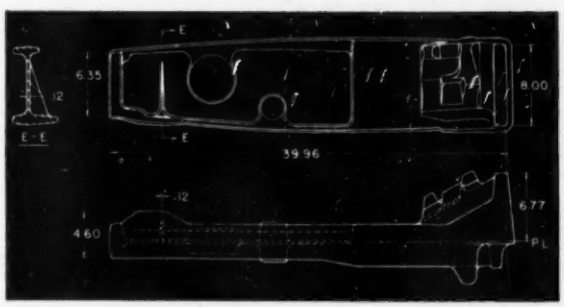


Fig. 1—Boxed-in type forging of 75S.

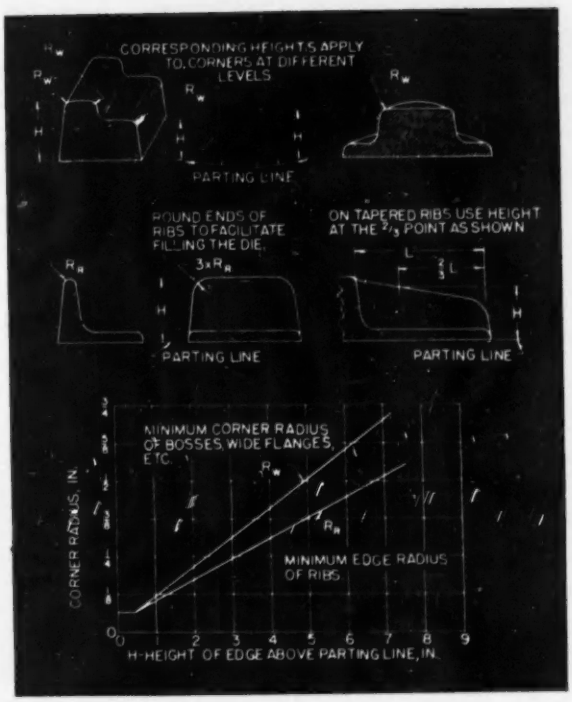


Fig. 2—Recommended minimum radii at corners and edges for assuring good metal flow and to obtain satisfactory die life.

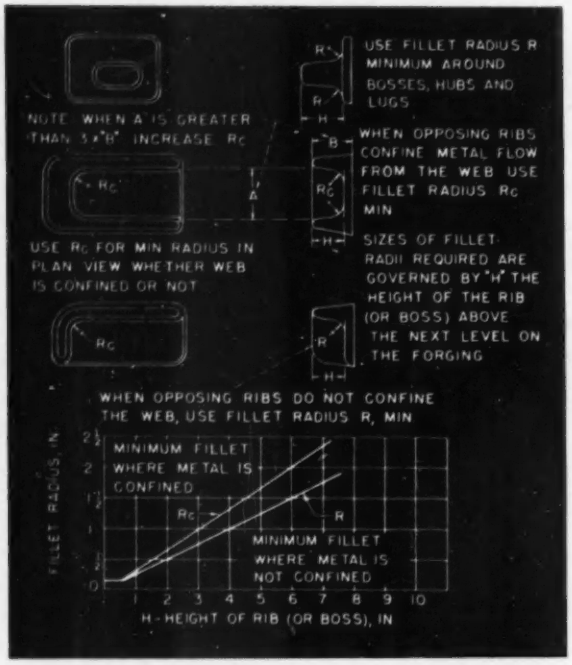


Fig. 3—Recommended minimum fillet radii on ribs and bosses in confined and unconfined metal of die forged aluminum parts.

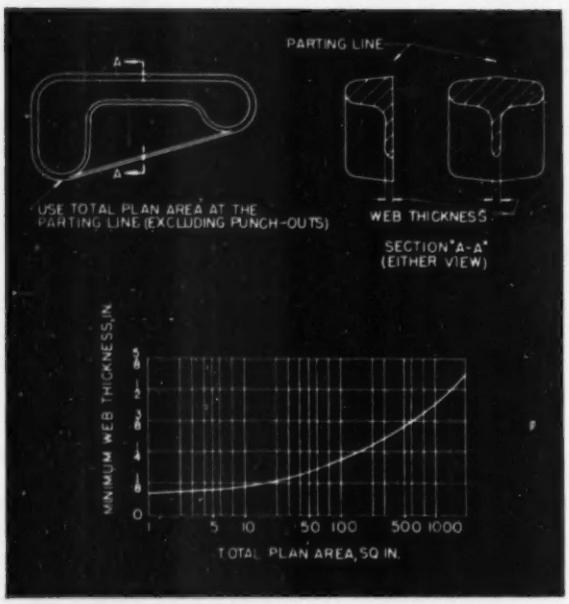


Fig. 4—Minimum web thickness of aluminum die forgings based on parting line areas. Punch-out holes not included in plan areas.

difficult or hazardous, deflection measurements are taken under pressure in order to stay within safe limits. It is believed that such deflection studies will be of major importance in the successful operation of the 35,000 and 50,000 ton presses, as the concentration of die stresses on such machines can easily reach such magnitudes that no material can avoid failure.

Inasmuch as thin web sections with thin ribs are so insistently desired and sought after by aircraft designers, it is in order at this point to examine some of the major factors which control the produceability of such design proportions. In the first place, these are joint responsibilities of the designer and the forging manufacturer, so that a cooperative approach between these two is most essential to any constructive result.

Reduction and control of required unit forging pressures sums up in a few words the conditions which must be achieved to produce forgings of relatively large area having thin web sections and narrow ribs to fairly precise dimensions. No amount of pressure will cause metal to flow if the conditions are not right, and no press, however powerful, will produce a thin web panel if the forging and the dies are improperly designed. The whole secret of such production lies first in proper forging design, secondly in proper die design, and third in proper production practices. The objective to be sought after and achieved in all three of these is the reduction of necessary unit pressures to the absolute minimum required.

If a press has a capacity of 50,000 tons and a forging requires 40 tons per sq in. to make, the machine can only produce a piece about 35 in. square. However, if by skillful design and fabricating practices this required pressure can be reduced to 15 tons per sq in., the press can fabricate a panel about 30 by 100 in. In other words, a 50,000 ton press becomes equivalent to 150,000 tons; or looked at another way, it may be reduced in effectiveness to 15,000 tons.

What are some of the things which the forging designer can do to assist in reducing the unit pressure necessary to produce his forging? Thin webs, particularly in "boxed in" sections (see Fig. 1), tend to "freeze" between the die surfaces and create enormous resistance to flow, and consequently build up excessive die stresses. If relief can be given by providing "punch outs," it provides some place for the excess metal to flow, which not only makes a thinner web possible, but greatly reduces the required pressure. Sometimes the designer cannot allow a "punch out," but perhaps can arrange the rib disposition so as to avoid completely "boxed in" sections and trapped metal. The point is that something can be done if the problem and the necessities are understood. A designer, bent upon maximum weight reduction, will often specify and insist upon very small fillet radii between web sections and adjoining ribs. Frequently he defeats his own purpose in so doing because the resistance of metal flow into the ribs is so increased that greater web thickness is required, or at least, in production the web section will always tend to run over the drawing limits. These are only typical examples of what is meant by forging design responsibility. The forging die designer faces still another set of responsibilities—but all with the same general objective, i.e., to reduce required unit pressures. He must determine the number of blocking dies and design the impressions in each, always with the idea in mind of providing the minimum resistance to flow and the optimum distribution of metal for the next operation.

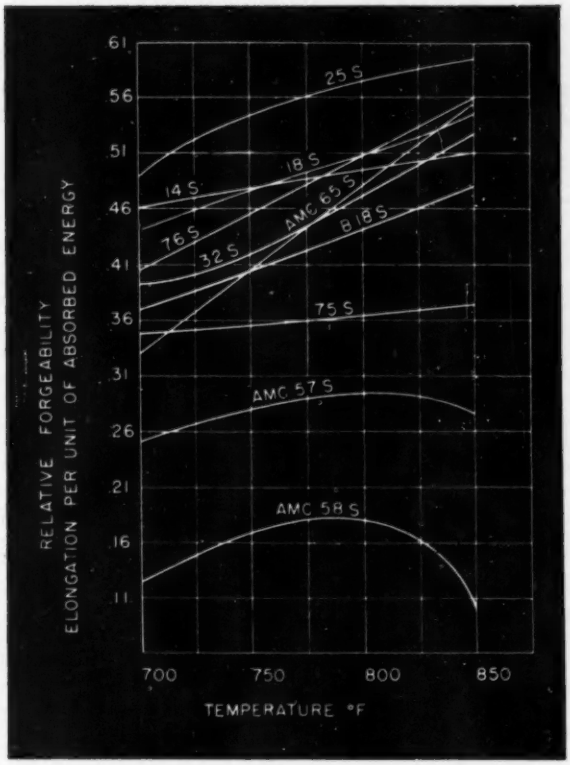


Fig. 5—Relative forgeability of aluminum alloys.

He must determine the type of original stock or preformed shape, whether to use sawing, bending, or perhaps hand forging as a preliminary operation. Gutter and flash design and flash removal are of extreme importance. Character of die surface has a large effect in reducing or increasing resistance to metal flow. Properly polished dies are very helpful—even plating may be warranted where practical.

In the actual production phase of the process, additional groups of controls and practices must be observed. Temperature of stock, temperature of dies, and lubrication of dies are major factors here.

It is not possible at this stage to set down definite standards giving practical design proportions and production tolerances, but the present ideas at Alcoa are offered for consideration. In the first place it must be thoroughly understood that very thin sections such as those contemplated for integrally stiffened wing panels are not considered as being practicable, or even possible, as forged. Such sections, i.e., 0.060 in. to 0.120 in. can only be achieved by subsequent machining. When speaking of "thin web sections as forged," we mean sections from about 0.140 in. to 0.225 in. Alcoa has produced nothing as low as 0.140 in. as yet, although some webs have been produced at 0.180 in. in rather heavily restricted sections without punch outs, up to about 100 sq in. in area; the total area of the forging being perhaps 300 to 450 sq in.

Figures 2, 3, and 4 indicate proportions that are currently used for hammer fabrication of large airframe forgings. For general purposes, as far as hydraulic press fabrication is concerned, these proportions could be reduced by approximately 25 per cent. However, it should be emphasized that each design, for the time being, should be given individual consideration until such time that sufficient experience is obtained to permit publication of definite design data and limitations.

Tables 1 to 4 indicate tolerances that have been established in the past for airframes produced on hammers. There are factors affecting tolerances that are common to both hammer and hydraulic press methods of fabrication. With proper control of stock volume, stock temperature, die temperature, lubrication and surface condition of dies, die closure, length and width tolerances can be held to a minimum. At Alcoa controls have been set up to hold these factors to fairly narrow limits. It is hoped to achieve still closer control of these variables in the future.

Deflection of dies and of the press bed should be held to a minimum, not only to improve tolerances but also to prevent die breakage and damage to equipment.

The control of mismatch tolerances must be given consideration. Proper design, control in set up of dies in properly guided holders, improvement in die sinking technique and methods of establishing uniformity

MAGNESIUM NET WEIGHT OF FORGING, IN LBS.		ALUMINUM NET WEIGHT OF FORGING, IN LBS.		DIE CLOSURE TOLERANCE, IN INCHES	
FROM	TO	FROM	TO		
0	¼	0	¼	+ 0.032	- 0.010
¼	1	¼	1	+ 0.032	- 0.015
1	3	1	4	+ 0.045	- 0.032
3	11	4	17	+ 0.062	- 0.032
11	16	17	24	+ 0.078	- 0.032
16	33	24	50	+ 0.093	- 0.032
33	67	50	100	+ 0.125	- 0.045
67	170	100	250	+ 0.187	- 0.062
170	—	250	—	+ 0.250	- 0.062

Table 1—Standard Die Closure Tolerances

DIMENSION, IN	A EXTERIOR DIMENSIONS	B INTERIOR DIMENSIONS	C STEP AND CENTER DIMENSIONS
UP TO 8	+ 0.032 - 0.016	+ 0.016 - 0.032	± 0.016
OVER 8 ADD PER INCH	+ 0.004 - 0.002	+ 0.002 - 0.004	± 0.002

Table 2—Standard Length or Width Tolerances

of die temperatures will all contribute in holding the mismatch tolerance to a minimum.

Forgings having thin webs and thin ribs together with small draft angles present definite problems in straightening. In producing such parts, warpage is apt to occur during the forging operation and during heat treating. Relying upon die or hand straightening, or a combination of both, has made it difficult to hold such forgings to a very close straightness tolerance. The ejection from dies of thin web forgings with small draft angles can result in distortion or even piercing of forgings.

Forgings having very small draft angles again present a problem of removal from the straightening die and we may have to resort to the use of mechanical ejectors. Such ejection may cause a bow; and it may be necessary to hand straighten after die straightening. These problems which confront the forging producer will have to be worked out in the future. They are not insurmountable. Perhaps with more experience, it will be possible to produce forgings with thin webs and small draft angles within desired straightness tolerances without having the above difficulties.

The stock employed for large hydraulic press forgings is produced under closely controlled practices, that are beyond the scope of this article. However, the care which is employed in ultrasonic inspection of forging stock should be emphasized including the inspection of pre-formed shapes. It is important that forging stock be inspected to a high level of quality because forging process will not substantially change the quality level inherent in the stock.

Intermediate or "in-process" inspection of forgings occurs between successive forging operations as a further safeguard of forging quality. Through these methods of control, it is believed discontinuities associated with ingot unsoundness have been largely eliminated. For this reason ingot and stock quality in the sizes required should not be a limiting factor in the production of large die forgings to be produced on 35,000 and 50,000 ton presses.

The relative forgeability of aluminum alloys affects the problems of production and, therefore, is directly related to the cost of such production. Fig. 5 shows relative forgeability of several commonly used forging alloys. It will be noted that the relative forgeability improves markedly with an increase of temperature. The normal forging temperature for most alloys is about 800 deg F, cracking or rupturing occuring if forging operation is performed substantially higher or lower than this value.

The forgeability of an alloy determines to a large degree the number of blocking operations required in order to attain a shape suitable for forging to size in a finishing die. An alloy that is relatively easy to forge, such as 25S alloy, should require fewer operations and fewer dies than the same part forged in 75S alloy.

As a general statement, the higher strength forging alloys have poorer forgeability than the lower strength alloys. Therefore, the forging designer should not specify an alloy of relatively difficult forgeability unless he requires the higher mechanical properties for that particular application.

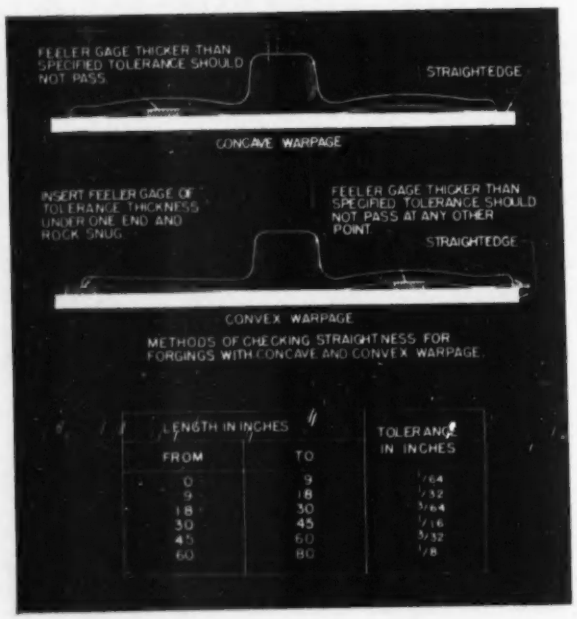
Steel procurement and the sinking of large dies is, and will be for some time, a serious problem. At present, Alcoa is having difficulty in obtaining sufficient die sinking sources for present requirements on the 15,000 ton hydraulic press. Die requirements for the 35,000 and the 50,000 ton hydraulic presses will be greater, so additional and larger die-sinking machines must be designed and built in sufficient numbers to provide for the necessary die requirements of forging producers throughout the country.

(*Turn to page* 80, *please*)

LONG, NARROW FORGINGS MAY REQUIRE LARGER MISMATCH TOLERANCES AS DETERMINED BY THE FORGING VENDOR

MAGNESIUM NET WEIGHT OF FORGING, LB		ALUMINUM NET WEIGHT OF FORGING, LB		TOLERANCE, IN
FROM	TO	FROM	TO	
0	1	0	1	0.015
1	5	1	7	0.018
5	9	7	13	0.021
9	13	13	19	0.024
13	17	19	25	0.027
17	21	25	31	0.030
21	25	31	37	0.033
25	29	37	43	0.036
29	33	43	49	0.039
33	37	49	55	0.042
FOR EACH 1½ LB EXCEEDING 37		FOR EACH 2 LB EXCEEDING 55		ADD 0.001

Table 3—Standard Mismatch Tolerances



LENGTH IN INCHES		TOLERANCE IN INCHES
FROM	TO	
0	9	1/64
9	18	1/32
18	30	3/64
30	45	1/16
45	60	3/32
60	80	1/8

Table 4—Standard Straightness Tolerances

Observations

By Joseph Geschelin

Free Piston

According to the survey paper on free-piston engines presented by A. L. London at the SAE Annual Meeting, it is believed that creative engineering talent of the first order, if applied today, should result in an early fruition of this revolutionary concept of engine design. What makes the immediate future so promising is the entry of General Motors Research into the picture. The author mentions that GM has engaged in a cooperative program with SIGMA. We learn from other sources that the GMR work undoubtedly will be done in cooperation with one of the larger GM Diesel divisions such as Electro-Motive, aiming at a free-piston power plant that might supplement, if not supplant, the big two-stroke Diesel engines for railroad applications. If the project is successful there is no good reason why it might not be extended to smaller power plants such as for heavy earth-moving equipment, for example.

Gas Turbine

The General Motors 370-hp gas turbine made big news in New York in connection with the great Motorama Show. Later, at press conferences with Curtice and Chayne, it was emphasized as purely an experimental project to probe the practicability of the device. What is significant is that GMR already has installed another version of the machine in a GMC bus, fitted with laboratory instrumentation, and will try it on the road. No intimate details have been released and all we know right now is that the GMR gas turbine is different in design from other makes. One thing is certain: the entry of GMR in this picture should presage faster action and may make the gas turbine a commercial reality much sooner.

Turbocharging Developments

High pressure turbocharging—with inlet manifold pressures of 15 to 30 psig—combined with proper intercooling is offered as the means for making the internal combustion engine competitive with new machines such as the gas turbine. That is the gist of the message brought by Rudolph Birman to the SAE National Meeting. He mentions, among other things, the Miller cycle, developed by Ralph Miller, chief engineer, four-cycle division, Nordberg Mfg. Co. Mr. Miller is an exponent of a new concept—a cycle combining the features of low compression ratio with high expansion ratio in an engine having variable compression ratio. The Miller cycle is embodied in the current line of Nordberg Supairthermal engines of large displacement built for stationary and marine use. What Miller does with big slow speed engines, he claims can be done with smaller high speed automotive type engines. Some of the experts dispute this. In any event, considering the evidence presented by Mr. Birman, Miller's work certainly deserves further exploration.

Strong Plastics

The several press conferences held in conjunction with the GM Motorama provided a definite picture of the present role of reinforced plastics. Glass fiber reinforced plastics are being used widely in building sport car bodies. The Corvette is probably the biggest plastic production job in the U. S. with a schedule of 1000 cars per month in 1954. Nevertheless, in the present state of the plastics art the plastic body does not represent competition for steel. Both Curtice and Chayne agreed that where large volume of production is concerned the steel body remains securely entrenched. But—reinforced plastics already play a major role in the industry. Apart from their use in building sports car bodies, plastics were employed in General Motors for the fabrication of show models and for the experimental production of new models for GM Divisions. This is a role of major significance. The use of plastics has reduced materially the lead time in producing experimental cars, has reduced the cost of making these jobs, and has simplified the problem of changes during trial stages. Reinforced plastics will have increasing uses from now on in many phases of automotive activity.

Machinery Replacement

In his Motorama address to a large gathering of industrialists, H. H. Curtice touched on some vital aspects of modernization of plant equipment. For one thing, he pointed out that manufacturers will be required to continue to invest large sums in plant and equipment so as to give their customers greater value for the dollar. Due to the effects of taxes and sharply rising prices, under currently accepted accounting procedures, worn-out and obsolete machinery no longer can be replaced solely through amounts provided for depreciation and obsolescence. This is one of the reasons for increasing the need for additional capital. "We recognize that in the period ahead it will be even more important to keep plants up to date and efficient, even if this means scrapping equipment before it is fully depreciated," Curtice said.

Controlled Explosions

The January issue of *Research for Industry* has a progress report on three years of work by the Extreme Pressure and Explosives Research Div., Stanford Research Institute. The Division has been conducting an intensive study of the theory of detonation and the mechanism by which energy is transmitted to a surrounding medium. SRI's research has been directed toward a precise control of the destructive impact of explosive charges. Besides the many variables involved in the problem is the fact that the detonation process is completed in less than one-thousandth of the combustion time in an internal combustion engine. The report mentions that the researchers have steadily advanced the understanding of high pressures and explosions. Unfortunately, only those contributing to the research study will have immediate access to its findings because of the usual confidential arrangement with research clients.

METALS

Less Nickel Available for Civilians as Government Again Adds to Stockpile. Stocks of Copper Show Large Increase.

By William F. Boericke

Civilian Deliveries of Nickel Cut

Expectation that a larger supply of nickel would be available for industrial users has been shattered by determination of the Government to build up further its stockpile of nickel at the apparent expense of non-military consumers. Starting this month, the Government will stop delivering 2 million lb per month from its controlled Nicaro plant in Cuba which was formerly consigned to the military and deliver the output to the stockpile. The principal nickel supplier, International Nickel Company Ltd. of Canada, has been notified to make up the deficit by delivering 2 million lb to the military and cut off that amount which has heretofore been available for industry.

Consequently International Nickel has notified the trade that it can deliver less nickel in future months. Officials estimate that industry will lose 1 million lb in March and double the amount in April. Protests made by company officials have been of no avail. It appears that Washington miscalculated nickel demand. They anticipated demand would go off when controls ended last October. This didn't happen. After easing slightly when a few concerns cut inventories, the demand became as heavy as ever in excess of supply.

The only concession made by the Government was that the stockpile goal would be reviewed at the end of the first quarter and it would then be decided whether to ease the requirements or to make them more severe. Consumers are disturbed by the announced cut in supplies, particularly the nickel platers who were short of nickel since the Korean war. When controls were lifted they had high hopes of an adequate supply once more. They may now be forced to return to use of unsatisfactory substitutes. Chrome stainless steel may once more get a big play.

New Nickel Sources to Be Developed

Washington has said that nickel supply in 1954 for civilian purposes would be about the same as in 1953. This is cold comfort, for the use was severely restricted until controls were lifted. At present only 60 per cent of non-military requirements from customers are being filled by International Nickel Co.

There is no doubt that Washington is genuinely alarmed and is doing everything possible to increase nickel production. The Nicaro plant will be increased 75 per cent in capacity, with expenditure of $43 million. Freeport Sulphur Company's nickel deposit at Moa Bay, Cuba, will get Government aid. International Nickel is making the first shipment under a contract calling for quick delivery of 120 million lb over a five-year period ending in 1958, for which a premium price will be paid. The head of DMPA calls the Inco contract by far the largest nickel contract signed by the Government, and adds that nickel remains a vital commodity in short supply, with the need to build our sources of production to the level that will equal military, stockpile, and civilian requirements.

Steel Outlook

The steel mills are operating about 74 per cent of capacity and there is not much hope the rate will improve for some time. January and February were definitely disappointing to the producers. The outlook for March, traditionally a good month for steel, is better, but few think that the rate will improve above 80 per cent.

There's no gainsaying that the market is intensely competitive, but as yet base prices have not been cut. However, with widespread freight absorption and elimination of extra charges, for practical purposes the effect is the same for the buyer. There are scattred instances of price cuts on special products but these have not been widespread. U. S. Steel announced a $4 per ton reduction in extras for steel sheets for moderate drawing requirements, and overnight the price was met by every competitor. Purchasing agents are well aware they are in the driver's seat and are pressing for additional price concessions.

Manufacturers of alloy and stainless steel report a pick-up in orders from the low level in December and January. Demand has improved from manufacturers of farm equipment and construction steel holds up well.

Most of the big integrated producers are doing fairly well. In contrast with the 74 per cent for the whole industry, at the end of January, Inland was operating at 100 per cent, Jones & Laughlin at 85 per cent, Bethlehem at 77 per cent, U. S. Steel at 80 per cent, Armco at 95 per cent. But the non-integrated plants need orders. Specialty producers are not happy.

The steel scrap composite price of *Iron Age* has declined to $26.67 per ton by the middle of February. Steel mills have not been buying. Users have large commitments to meet for iron ore and pig iron, hence orders for scrap are held to a minimum.

(*Turn to page 70, please*)

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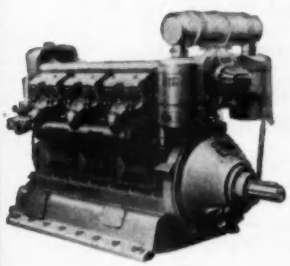
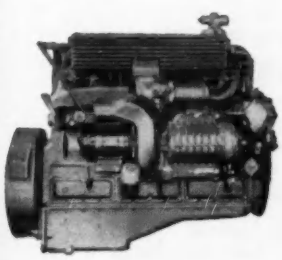


Model D-375—Caterpillar Diesel V8



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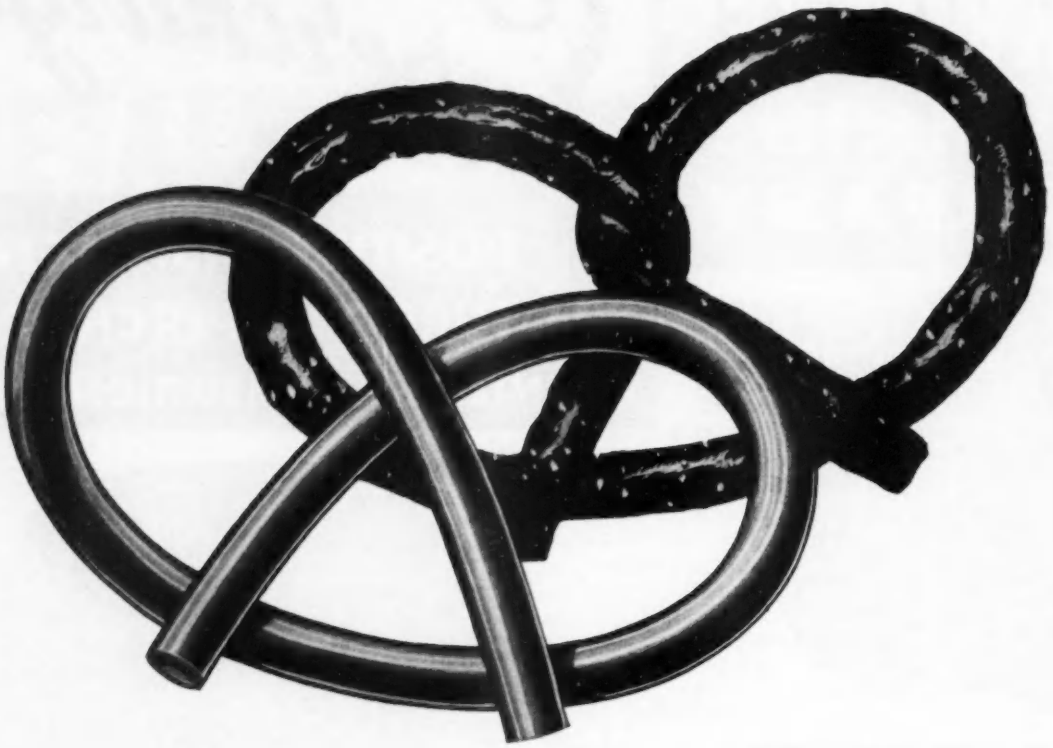

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EXPORT: COPPERWELD STEEL INTERNATIONAL COMPANY 117 Liberty Street, New York 6, New York

News of the MACHINERY INDUSTRIES

By Thomas Mac New

Machine Tool Orders Show Gain and Cancellations Fall Off. Another Manufacturer Announces Plan to Lease Machine Tools.

Pick-Up Expected In Tool Orders

Favorable action by the House Ways and Means Committee on accelerated depreciation for machine tools and equipment is expected to add impetus to the pick-up in orders experienced by the machine tool industry during December 1953. The committee's proposal to put tool amortization on a "declining-balance" basis is considered to have an excellent chance of adoption by Congress this year.

Preliminary reports on January new orders indicate that the machine tool business enjoyed a pick-up from December which also had shown a slight gain from November. About $44 million in new business was placed in December, up 1.5 per cent from November, but nearly 35 per cent below the same month a year earlier. Machine tool companies also report that cancellations have fallen sharply. The order backlog in December stood at 5.8 months at current production rate compared with 6.1 in November.

Estimates for the industry this year are varied, ranging from $600 million to $900 million. It is believed that if this year's business is somewhere between $600 million and $700 million, machine tool companies still will be able to operate at a profit despite an expansion in productive capacity of almost double that of the pre-Korean war period.

Another Lessor

Warner & Swasey has announced that it will lease machine tools on a special plan. This is the second machine tool company to make public a plan whereby it can possibly keep a large volume of new machinery rolling off its production lines in the competitive period ahead.

Cross to Expand

Cross Co. has authorized expenditures of more than $1 million this year for new equipment to produce machine tools. In addition, it has made provision for expenditures of $4 million more for new plant and equipment over the next five years. Employment increased 20 per cent last year and will make a similiar percentage increase this year, according to Merton O. Cross, Jr., president.

Ralph E. Cross, executive vice president of The Cross Co., Detroit machine tool builders, has been named director of the metal-working equipment division, Business and Defense Services Administration, U. S. Department of Commerce. Mr. Cross will be located in the Commerce Building in Washington, and is serving under an arrangement whereby outstanding businessmen work for the Government without compensation on a rotating basis.

Setting Up for Competition

Jones & Lamson Machine Co. announces a reorganization of its operations in Springfield, Vt., with the formation of three decentralized operating divisions, the setting up of a Marketing Division and the creation of the position of manager of manufacturing. This new organization is designed to meet the competitive situation the industry is entering and to place the company in a better position to become an even more important factor in the machine tool industry. The formation of three operating divisions—machine tools, comparator, and thread tool—each under the direction of a manager and a complete operating staff, provides greater concentration of effort on every operating problem of each product produced by the company. The creation of the new Marketing Division places all district office organizations, agents, distributors, public relations and advertising, market research and sales analysis, as well as all sales policies under the direction of Howard A. Finch, who has been named manager of that division. Creation of the position of manager of manufacturing and the oppointment of Robert S. Jones as manager places resposibility for all manufacturing and labor policies for the entire company under the direction of one individual and will insure the use of modern methods and policies in each of the three divisions.

Harold Byron Smith, president, Illinois Tool Works, Chicago, has announced that the company has decentralized its Shakeproof Division along product lines, physical facilities and organizational responsibilities. Decentralization of Shakeproof, as outlined by Smith, subdivides the division into three hard hitting production units, each housed in its own plant and with its own organizational group, headed by a general manager. The three subdivisions are: standard products, special stamped products, and plastic products.

NEW PRODUCTS

FOR ADDITIONAL INFORMATION, please use postage-free reply card on PAGE 17

Porous Vinyl Is in Production

Production on a new line of breathable vinyl upholstery has begun. Breathable Naugahyde is made on new machinery developed in the rubber company's Mishawaka, Ind., plant, so the porous, breathable feature is part of the basic construction. It is said to assure complete seating comfort when used over foam rubber cushioning or deep springs.

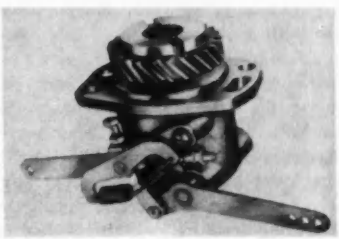
Breathable Naugahyde vinyl upholstery is now being made in four colors—turquoise, grey, dark green and maroon—and can be made in a variety of colors, textures and patterns. It has a strong cotton fabric backing and has a slip finish. It is easy to maintain since it won't absorb dust. *U. S. Rubber Co.*

Circle 36 on page 17 for more data

Gear Drive Governors Meet Specifications

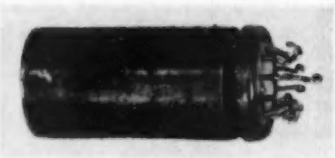
A line of gear drive governors now available meet all Government specifications for accuracy in control, recovery and service life, and afford various types with flanges and control levers designed for specific engine application. They provide closer regulation over a wide operating range, without spring change by means of an exclusive external two-spring system. They employ ball or roller bearings at all load points to minimize friction. The large oil capacity and use of oil seals throughout, eliminate the need of daily oilings. *Hoof Products Co.*

Circle 37 on page 17 for more data



Computer Transducer Is Like Thermocouple

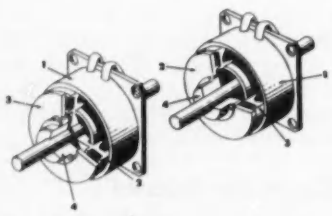
An analog computer component of approximately three cu. in. size has been developed. It does calculations by the interchange of heat. It has no moving parts, is mass-producable, and promises to become important in the automation of airborne equipment as well as a variety of things for industry. For instrumenting problems of multiplication, which is one of many mathematical functions it can be made to do, it replaces five times its weight and volume heretofore required. *Arma Corp.*



Circle 38 on page 17 for more data

Small Electric Brake, Clutch Line

A unique design and operating principle in small electric brakes, clutches and clutch-couplings for fast, accurate control of low-torque drives has been announced. Smaller than a man's hand, they feature high-speed engagement and release and unusually high torques for starting, stopping, indexing, rapid cycling, synchronizing, torque limiting, indexing and jogging and single revolution cycling applications on small machinery. Parts of the stationary-field coupling, left, are (1) field, (2) rotor, (3) armature, and (4) hub. The replaceable-face brake parts are (1) stationary field, (2) armature, (3) replaceable friction surface, (4) hub.

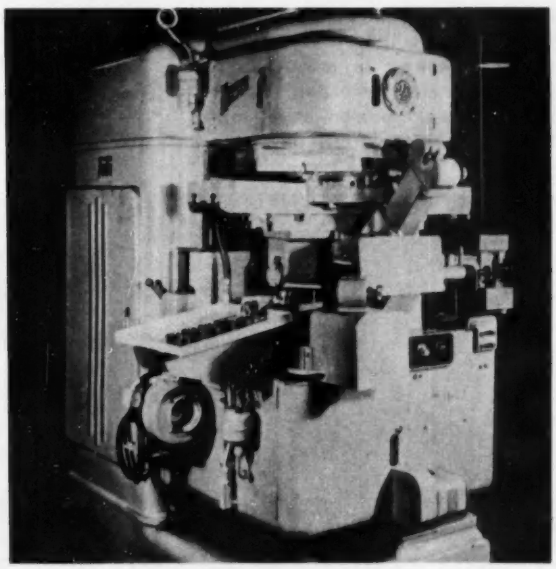


Warner Electric Brake & Clutch Co.

Circle 39 on page 17 for more data

FOR ADDITIONAL INFORMATION, please use postage-free reply card on PAGE 17

Shaver Adapts to Two-Gear Cluster



Side view of Michigan 870 underpass shaver. At right of machine are the two cylinders; one is used to bring the gear into position for shaving, the other brings the arbor into the gear.

In production shaving of a two-gear cluster for farm tractor transmissions, the same machine is used to finish both gears in the cluster. It must be capable of performing the shaving operation to the required accuracy with a minimum time loss for changeover.

To attain a production rate of about 240 gears per hour a model 870 underpass gear finisher is automation equipped. The only operator attention required is putting parts into the loader. An automatic sizing fixture at the entry end of the loader prevents the loading of oversize parts, so that only gears that are within size limits for shaving pass through. This results in faster shaving and more accurate gears as well as giving maximum cutter life.

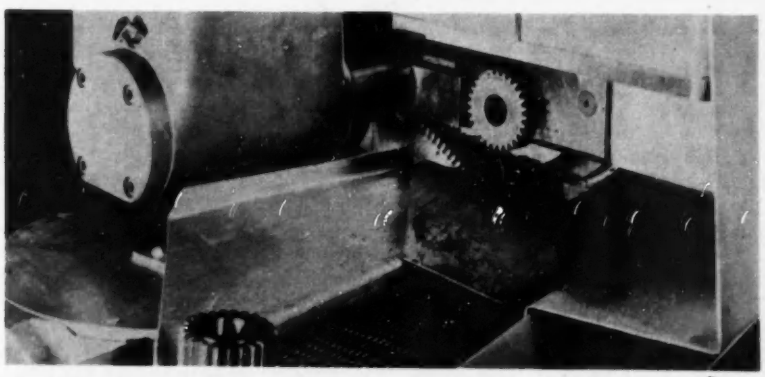
Since the gears have different numbers of teeth and pitch diameter, the machine setup is changed for each shaving operation. Only three steps are required in the changeover and are accomplished in a few minutes: Center distance is changed by means of a handwheel; sizing fixture is changed by removing four bolts; and the sub-plate, mounting the head and tailstocks and the loader, is positioned by lining up locating markers (visible at front of machine).

A cylinder pushes the gear to be shaved into a round carrier with a diameter equal to that of the larger gear. When a limit switch is tripped on retraction of the cylinder, a second cylinder at the back of the machine pulls the gear into shaving position. An arbor moves into position and holds the gear for the shaving operation. Movement of the arbor into position causes a limit switch to be tripped, starting the underpass shaving cycle.

When the cutter stops at the end of the shaving cycle another limit switch is tripped causing the arbor to retract and the gear carrier to return to loading position. The next gear being moved into shaving position pushes the finished gear onto a chain conveyor which carries it to a stock tray or to another conveyor, as desired.

During the shaving operation, 0.005 in. of stock (measured over two pins) is removed. The 23-tooth gear, is shaved at a rate of 240 per hour with output of the 28-tooth gear being slightly lower. *Michigan Tool Co.*

Circle 56 on page 17 for more data



Closeup of gear being brought into position for shaving. In left foreground is the conveyor used to take finished gear away from machine.

NEW EQUIPMENT PLANT • PRODUCTION

For additional information, please use postage-free reply card on page 17

Life-Line-A Motors are Completely Changed

The new Life-Line-A integral horsepower induction motor is now in production in one- and two-hp models. All conform to the new suggested NEMA standards which call for smaller motors per horsepower. In addition, there are to be found improvements in insulation, a more efficient and better protected bearing, an improved ventilating system, and quieter operation.

The new **Bondar** wire insulation used is a synthetic resin insulation. In the test, research, and development stages for fifteen years, it is said to have a life over three times that of other motor wire insulations now in use because of its higher thermal endurance, at no sacrifice in dielectric strength.

Slot insulation on the new motor is a combination of the Du Pont Mylar polyester film and rag paper. In tension tests, this combination of the same dimensions used in the motor will take up to 360 lb before failing. It occupies less space than the previously used varnished cambric and paper, has a dielectric strength four times that of varnished cloth, and a heat endurance of three to four times more.

The Bondite dip insulation on the stators is a clear phenolic-alkyd thermosetting-type varnish. It is fortified with water-repelling silicone and has, at elevated temperatures, a life of 170 per cent of the previously used varnish.

The motor leads are smaller in diameter and more flexible. Life of the insulation is twice that of previously used cable or lead insulation at normal operating temperatures, and it is rated at 75 C compared to 60 C for previous cable insulation.

The ventilation openings in the straight-through design are comparatively small and are located normal to the shaft axis in one quadrant of the periphery of the end-brackets. This position makes the motor much better protected from drippings. The end-brackets can be rotated to any position to make the motor completely dripproof.

The effective volume of electrical sheet steel in the new motor is about 15 per cent less than in the old. The weight of copper is practically the same. The steel reduction has been made through proper selection of high-grade silicon steel, thereby reducing losses for a given flux density by as much as 20 per cent.

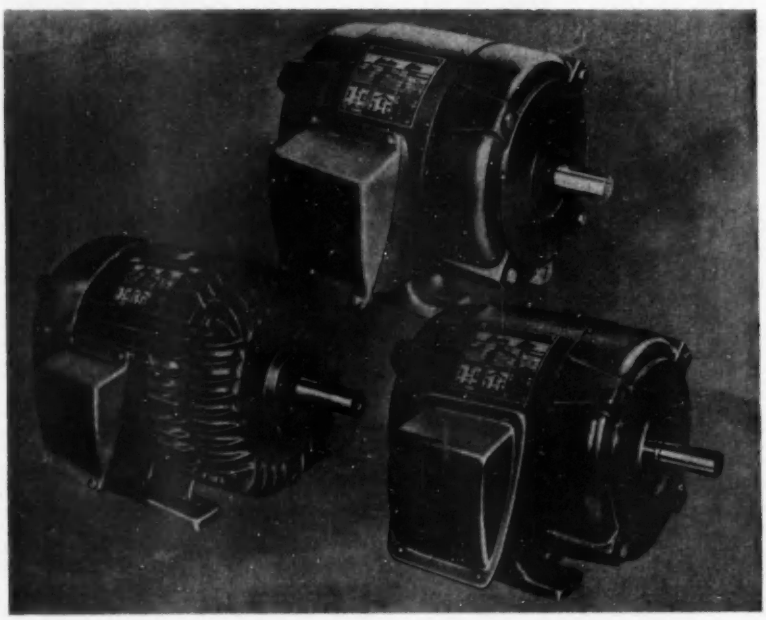
Bearings have a four-way seal—two on each side of the motor bearing. The inner seal is stationary and is attached to the outer bearing race, while the outer seal rotates and is attached to the inner bearing race. The function of the rotating outer seal, or flinger, is to throw off any foreign elements trying to enter the bearing. Pre-lubricated bearings on the new motor indicate to the user that he need spend no time on bearing and lubrication maintenance. The grease used in bearings for the new motors has been developed in coordination with supplier companies. A combination bearing by-pass and a neoprene external flinger equalizes the pressure on both sides of the bearing, thereby stopping contaminated air from passing through the bearing.

The blower on the totally-enclosed fan-cooled motor is a molded glass plastic with high corrosion resistance. The frame for the totally-enclosed fan-cooled motor has fins to provide maximum area for heat dissipation and to allow greater ease in cleaning. All the exposed parts of both totally-enclosed non-ventilated and totally-enclosed fan-cooled motors are corrosion resistant.

The frames—both stator frame and end-brackets—are made of cast iron. The dripproof enclosure has been improved to such an extent that it is now virtually splashproof, and the splashproof enclosure has been consequently eliminated.

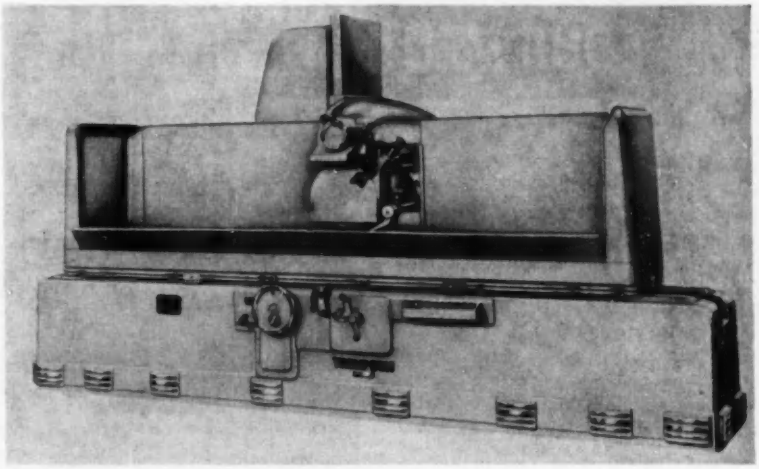
One of the big mechanical accomplishments in this new motor is the reduction in noise. For an open 1800-rpm motor in the lower horsepower range, the sound level of older motors ranges from 55 to 60 decibels, while that of the new version lies between 50 and 55, or about the same as the noise level in the average office. *Westinghouse Electric Corp.*

Circle 58 on page 17 for more data



The Life-Line-A motors, from the left, are the totally-enclosed fan-cooled, totally-enclosed non-ventilated, and the drip-proof motor.

Grinder Line is Introduced



The Thompson Type C Grinder.

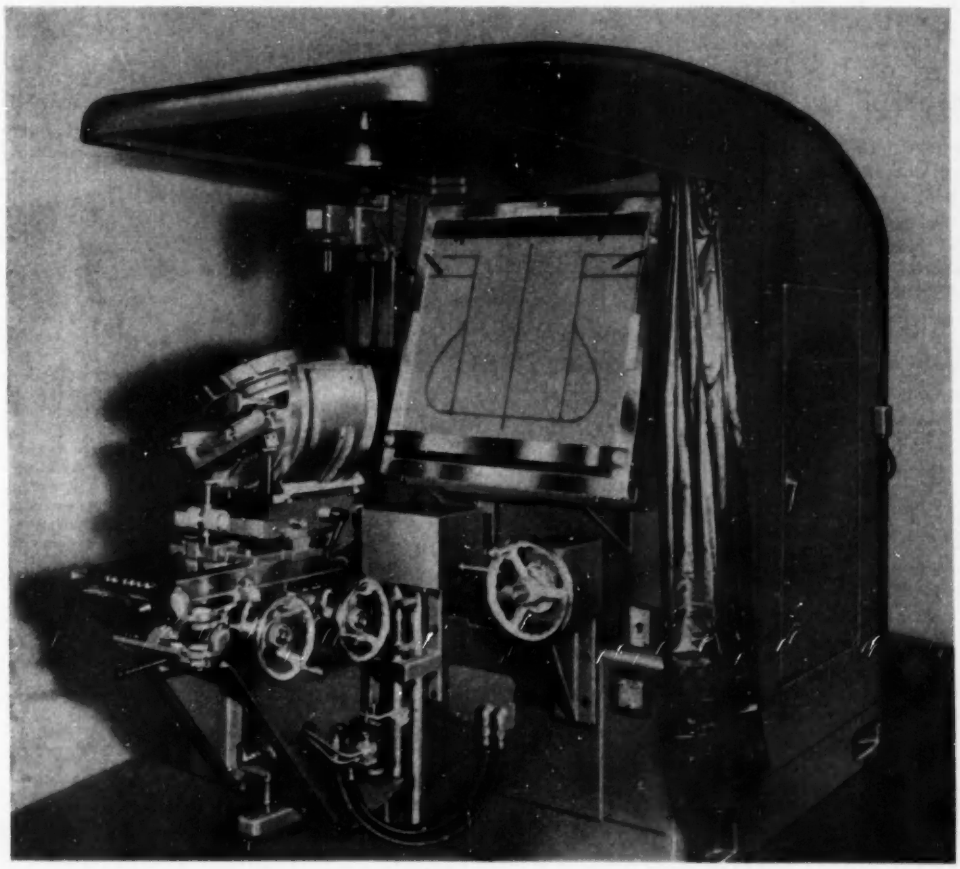
The line of production surface grinders known as Type C range in size from 12 by 48 in. to 24 by 168 in.

The grinders feature a patented anti-friction elevating nut to eliminate windup between nut and screw. Power elevation and hydraulic rapid traverse are provided with safety stops. Table speed is variable from 10 to 100 fpm, and cross feed control is variable in increments of 1/32 in. to one half of wheel width per table reverse.

Fast sparkout plus small increments of down feed and wide increments of cross feed at 100 fpm table speed provide high accuracy and quality of finish. Other features include a heavy work table support with bed ways twice the length of the table for extra rigidity and flame hardened cross slide ways. *Thompson Grinder Co.*

Circle 59 on page 17 for more data

Comparator for Inspecting Slots in Gas Turbine Disks



This comparator will inspect slot contour, angular locations, and spacing on gas turbine disks from 12 to 36 in. diameter. Vertical travel of the work table is hydraulically operated with a servo mechanism. The 30 in. square receiving screen is of sufficient size to permit the use of projection lenses of suitable area to encompass most slots at magnifications of 31.25 or 50 times size. The staging fixture with suitable sine bar arrangement is rigidly constructed for supporting heavy disks. It will tilt the disk up to 50 deg either right or left for slot angle, and up to 15 deg for face angle of slot to the axis of the disk. Slot spacing measurement is accomplished with a graduated ring and vernier. (Jones & Lamson Machine Co.)

Circle 60 on page 17 for more data

NEW EQUIPMENT PLANT • PRODUCTION

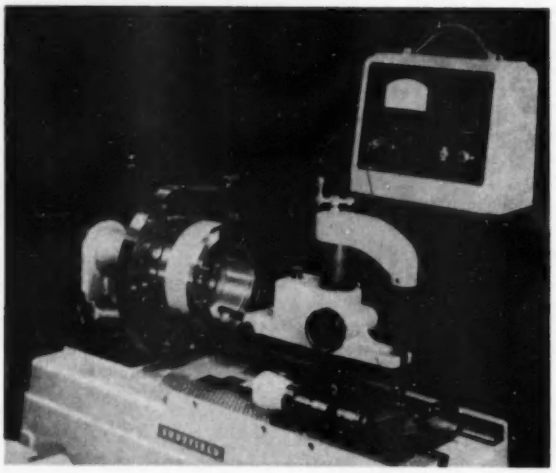
For additional information, please use postage-free reply card on page 17

Ring Gage Tester

A bench-type electronic precision measuring instrument for gaging lead, taper, straightness and concentricity of straight and tapered plain and thread ring gages, has a capacity for checking ring gages up to eight in. maximum ID and 10 in. maximum OD.

The instrument consists of a rigid cast iron base on which is mounted a rotating face plate, an electronic pickup stylus on a gaging arm that is adjustable vertically on a column mounted on a ball bearing slide, a micrometer screw for use with precision end measures, and an electronic amplifying indicating unit. The rotating face plate can be swung through a 90 deg arc to come to rest upon a horizontal precision sine bar fixture.

The electronic amplifier with an amplification of 2000 to 1 can be remotely located for operator convenience. It has a zero center equilinear scale directly graduates in half "tenths" (.00005) with a range of 0.0015. Interchangeable ball point gaging tips, sizes 0.030, 0.050, 0.080, and 0.125 are supplied with the instruments to permit the gaging of almost any thread. Lead is checked by presenting the stylus to the thread at the proper intervals as determined with end measures, and reading the error on the micrometer. *Sheffield Corp.*



Ring gage checker for lead, taper, and straightness

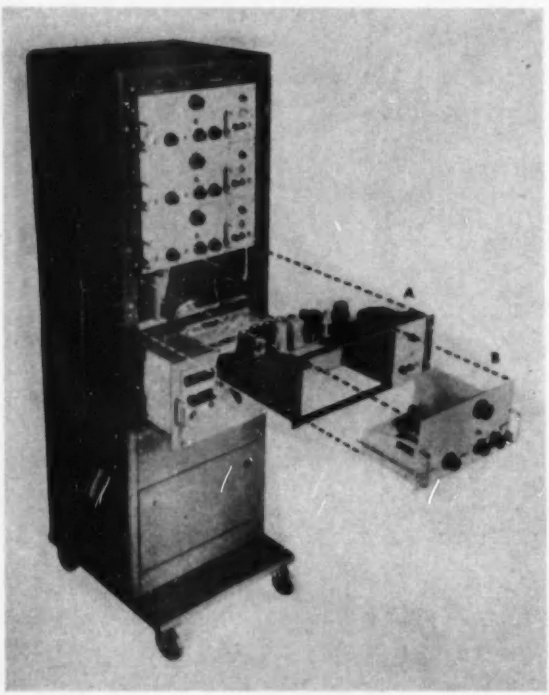
Circle 61 on page 17 for more data

Plug-in Oscillograph

A four channel oscillographic recording system provides a unique combination of interchangeable plug-in elements. They make the system applicable to the graphic registration of almost any phenomenon (individually or up to four simultaneously) within the frequency range of zero to 100 cps.

Called the Model 150, the system consists of a vertical cabinet containing a four channel recorder assembly, and a built-in driver amplifier and power supply unit A, which are already in place, for each of the four channels. The preamplifier B required for the specific application, is plugged in to the appropriate channel. By changing the plug-in preamplifier, the system is adapted to recording an extremely wide variety of phenomena including stress, strain, pressure, displacement, thickness, velocity, acceleration, current, voltage, temperature, torque, light, flow, force, load, position, rpm, radiation and tension.

Standard plug-in preamplifiers now available include: ac-dc, carrier, dc coupling, servo monitor, log-audio, and low level. Blank plug-in assemblies are also available so that the user may make his own special input circuits if desired. *Sanborn Co.*



Other Sanborn improvements in this series include: extended frequency response, improved regulated power supply, and stylus temperature control for each channel.

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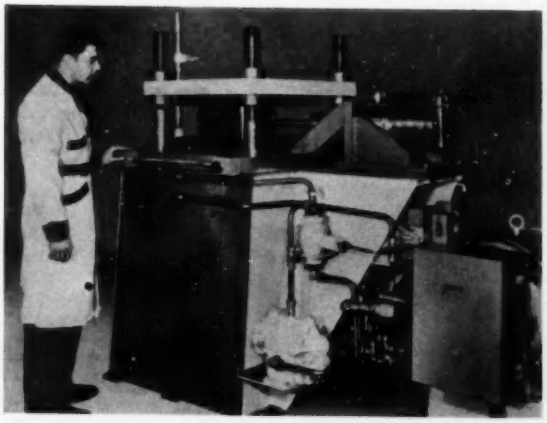


A 175-ton Hill inverted hydraulic press, with 20 by 24-in. die area, six-in. travel, 27-in. open height.

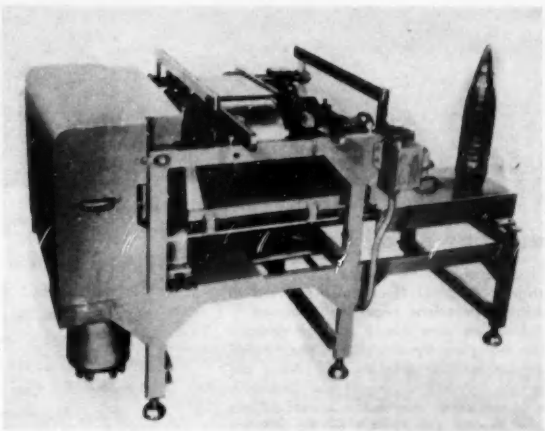
Special Tool Board Saves Setup Time

Each cutting tool is graphically identified as to size, station, tool number, and adapter size on this special tool board now in use on a multiple-spindle machine. Standard pre-setting gages simplify and speed accurate setting of tools, duplicating the holding method of the machine. The maker's adjustable adapters are used to permit accurate depth adjustment. The tool boards and benches are designed specially for original equipment or user applications. (Scully-Jones and Co.)

Circle 63 on page 17 for more data

Marker Prints Cans, Shells

This automatic marking machine for printing on heavy cylindrical objects has been scheduled for production. The model 55A can automatically receive, print and eject the objects being marked, or can be manually fed if desired. Inking and printing mechanism slides out from the side of the machine for easy access when built into conveyor or production line. Object capacity ranges from three to 10 in. in diameter, five to 100 lb in weight. Imprint area is up to nine by nine in. (Markem Machine Co.)



Circle 64 on page 17 for more data

Versatile Inverted Press

A new line of inverted vertical hydraulic presses adaptable to a wide variety of stamping and extrusion operations have their hydraulic control cylinder in the base of the machine. This feature reduces overall height, avoids shut height limitations, lowers center of gravity and provides areas at the top and sides for the mounting of auxiliary hydraulic cylinders.

These inverted presses are adapted to bending and extrusion operations on ferrous and non-ferrous parts as well as upsetting, drawing and coining operations that would require special auxiliary equipment on standard presses. Stampings requiring deep draws and additional auxiliary operations, and multiple operations such as piercing or deforming can be performed.

Die capacity of the presses can be easily increased by providing long guide rods. Large press bed areas avoid the necessity of installing auxiliary die guide equipment to obtain perfect die register.

The base of the presses is welded steel construction. A hydraulic cylinder, operating on 5000 psi pressure supplied by a five to one hydraulic booster, is flange mounted on the bottom side of the die table. This cylinder has its piston rod in a vertical position extending downward toward the base of the press.

The hydraulic cylinder imparts vertical motion to the upper die platen through four widely spaced rods that are guided in individual bronze bushings in the press table. Vertical die travel is limited only by the stroke of the cylinder. Variable shut height adjustments are made by turning spanner nuts on the threaded ends of the four actuating guide rods.

Auxiliary hydraulic cylinders for controlling extrusion, forming or drawing operations can be mounted on top of the platen or on plates with fabricated bases on any of three sides of the die.

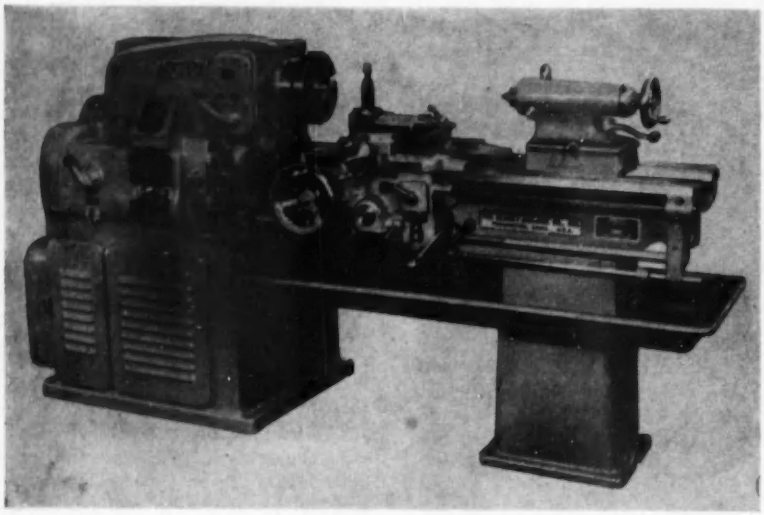
After loading the press goes through an automatic operating cycle: The dies close, the auxiliary cylinder or cylinders at various locations on the machine extrude the tube to the desired form, and the dies open.

Release of pressure on either or both pushbutton controls during the cycle before die closure causes the upper die to immediately retract to upper position, where it remains until the buttons are both simultaneously depressed. *Walter P. Hill, Inc.*

Circle 65 on page 17 for more data

NEW EQUIPMENT — PLANT • PRODUCTION

For additional information, please use postage-free reply card on page 17



Various bed lengths are available on the Hendey No. 2E.

Precision Lathe

The No. 2E 14-in. general purpose precision lathe, equipped with electronic motor control, features infinitely variable spindle speeds with single dial control. Speeds can be changed while machine is under cut.

The electronic drive contains only three 18-amp, heavy-duty rectifier tubes in the power circuit, and one smaller rectifier tube in the control circuit. Positive, no-slip belt drive is provided between motor and work spindle. Stepless speed, ranging from 15 to 1500 rpm, is provided by potentiometer control of both field and armature of the five-hp, d-c motor. Full torque is attained at low speeds over the complete armature control range.

Due to provisions for extra capacity and the unit's inherent ruggedness, current limiting is unnecessary. A thermal overload relay protects the motor from sustained overloads. The unit is unusually quiet during operation, even under load.

Instantaneous electric dynamic spindle braking plus start, stop and reverse are controlled by duplicated single levers at the headstock and apron. *Hendy Machine Co.*

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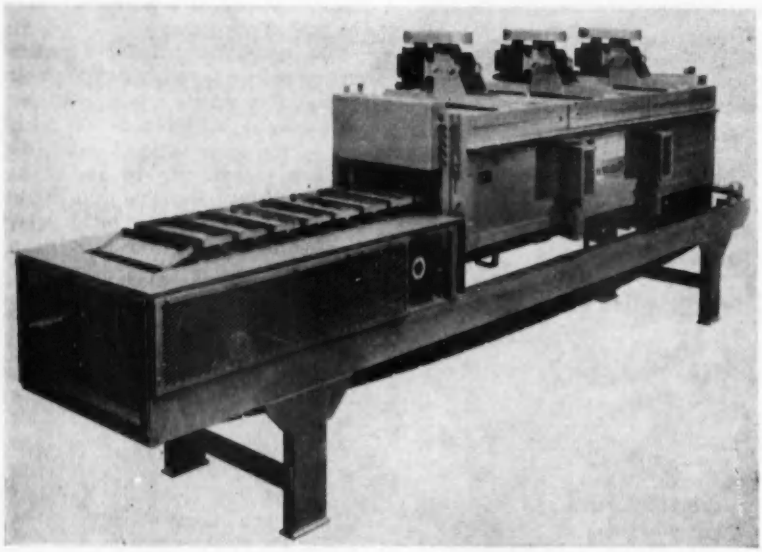


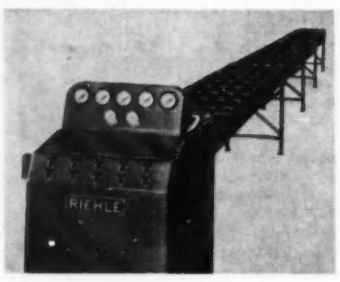
Conveyor Furnace for Large or Small Parts

This conveyor furnace was ordered by a large manufacturer of jet engine parts for the purpose of heating aluminum and brass billets prior to forging. It can also be used to temper, anneal, stress relieve, or do other heating operations requiring a maximum temperature of 1650 F. Elements are of nickel chromium wire wound through ceramic refractories. Three fans speed the heating of the materials by circulating the heated air, assuring an even and uniform temperature in the heating chamber. The trays are designed so small parts will pass through the furnace without falling off the conveyor. Within easy reach of the operator is a variable speed drive mechanism which adjusts the conveyor speed. By this control, parts to be heated can remain in the furnace chamber from 13 to 130 min. (Hevi Duty Electric Co.)

Circle 67 on page 17 for more data

Proof-Tests Cable

A tester for prestretching and proof-testing aircraft cable and other wire assemblies, with a 6500-lb capacity, tests five different sizes of cable simultaneously, it is claimed. Built with separate tensioning units, all with different ranges, each unit



Riehle cable tester.

can be preset to exert any load within its range, for any period from three seconds to 20 minutes. This automatic tester meets specifications of the Naval Bureau of Aeronautics, according to the manufacturer. *Riehle Testing Machines Div., American Machine and Metals, Inc.*

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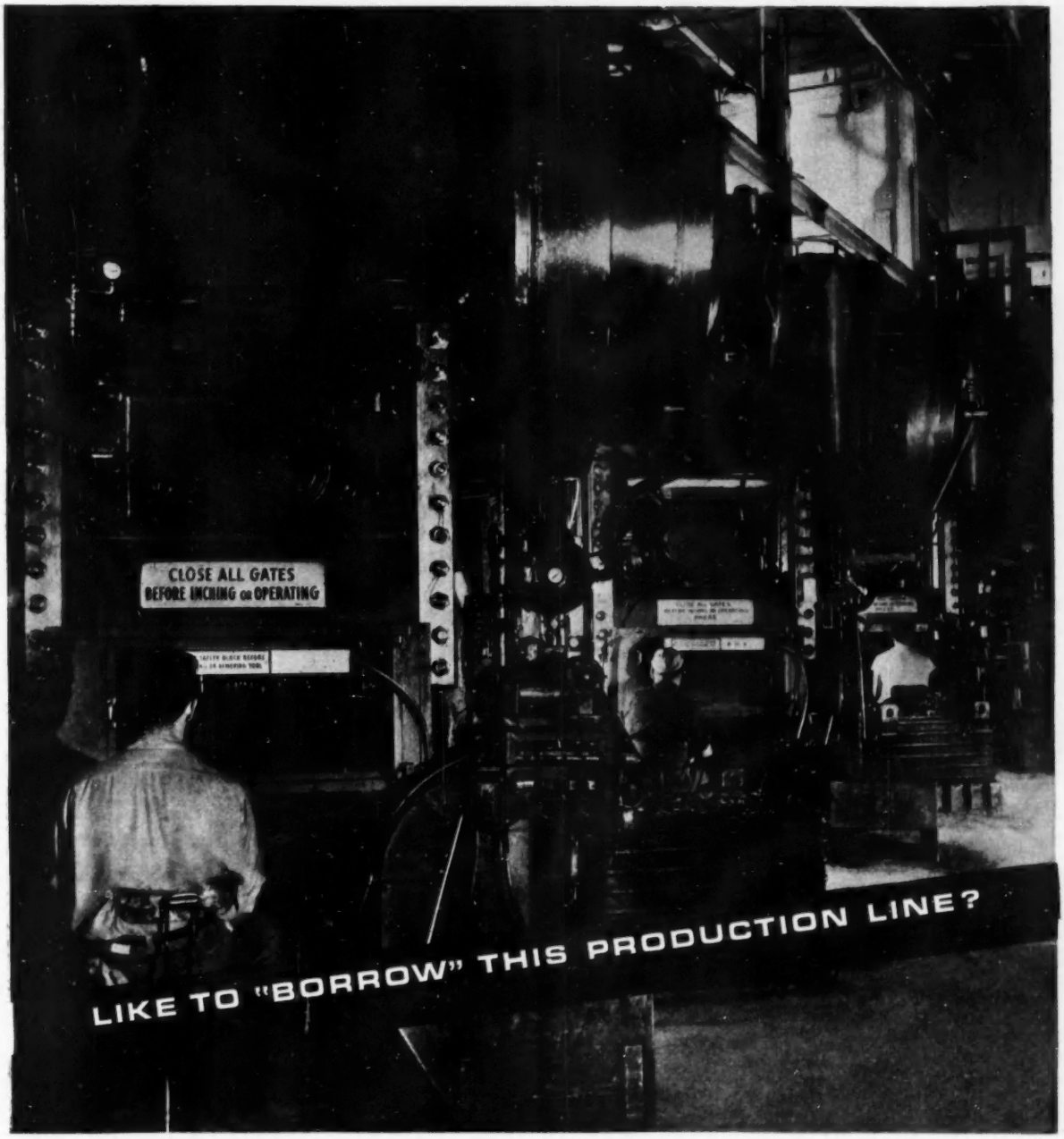


IF you need a dependable source of supply for your small, precision stampings, these Thompson production facilities are ready to go to work for you.

This high-speed production line, one of many in Thompson's Special Products Division, is fully equipped to produce large quantities of small stampings for a wide variety of customer uses—ranging from automotive parts to door locks, electrical appliances, and many others.

And, along with these production facilities, you can also "borrow" the skills and manufacturing know-how of Thompson's experienced engineers. Refer your small-parts stamping problems to Thompson Products, Inc., Special Products Division, 2196 Clarkwood Road, Cleveland 3, Ohio.

You can count on Thompson Products

SPECIAL PRODUCTS DIVISION

2196 Clarkwood Road • Cleveland 3, Ohio

METALS

(*Continued from page 58*)

Copper Production Cutbacks

January shipments of copper to domestic users were the lowest in four years, totaling only 77,091 tons. At the same time stocks in the hands of producers at the end of January increased to over 108,000 tons, a record since 1949.

The overall record, however, is not altogether discouraging for foreign shipments of copper mounted to 92,277 tons, the best for any month since 1952. Deliveries abroad have gained steadily since last August. It would appear that Continental buyers completed their inventory adjustment months before U. S. consumers started to cut back, and may be expected to increase their takings. This would relieve the heavy exports to this country and to that extent relieve pressure on our market.

Nevertheless there is tangible evidence the Big Three in the domestic copper industry, Kennecott, Phelps Dodge, and Anaconda, are fully aware of the possibility of over-production and are taking steps to forestall this. Instead of cutting the price to encourage buying—a policy that seldom succeeds initially—they are taking steps to prevent a copper surplus by limiting output. The big producers have cut back production by about 10,000 tons per month, or 12 per cent of the monthly average output in 1953. If these cutbacks continue, there will be a loss during the year of some 75,000 tons of new copper.

The copper price has held amazingly firm since the first of the year at 29½-30 cents per lb, but buying interest has been confined almost wholly to spot and nearby positions. Forward metal has been available at concessions but has found few takers. No settlement of the Chilean impasse was in evidence in mid-February. It is generally believed the copper price will hold firm until some arrangement is worked out with the Chile government. This might occur in March.

While copper has held firm, ingot brass prices have been cut for the fourth time and by mid-February were seven cents below the old OPS ceiling and nine cents below the post-control high. Orders have dropped 30 per cent below last year's level. Buyers are convinced a cut in the copper price is on the way which would affect brass. But producers say their present price reflects 25 cent copper.

Zinc Stocks at New High

For the eighth consecutive month, zinc producers reported an increase in unsold metal on their hands, now nearly 200,000 tons at the end of January. This was worse than expected, and amounted to an increase of nearly 18,000 tons during the month.

This finally stirred the zinc smelters to curb their output. Announcement followed rapidly from the leading smelters of cut-backs that totaled 13,350 tons from the normal rate, or about 18 per cent. St. Joseph Lead Co., a leading zinc producer, lopped off 33 per cent.

The most recent cut in the zinc price to 9½ cents per lb, which is less than half the old OPS ceiling of 19½ cents, failed to generate buyers' interest. Demand remained inactive. All experience shows it is nearly hopeless to expect any price recovery until buyers are convinced the trend has been reversed in accumulation of stocks and inventories start to decline. Buyers know they can get all the zinc they want at short notice when they require it and refuse to place orders ahead.

The prospect for recovery is none too bright. With the rate of steel activity at 74 per cent, galvanizers are unlikely to experience any better demand. Aluminum continues to offer sharp competition in the die-casting field although less keen with zinc half the price of aluminum. The brass industry, third largest outlet for zinc, is running on a reduced work schedule. Meanwhile zinc imports continue large, although the rate is substantially lower than the 1953 peak.

There is a better prospect for relief for the domestic industry through a tariff increase under the Escape Clause, or by a subsidy to be granted to U. S. producers. So bad is the plight of the industry that the Administration is likely to use its influence to obtain favorable legislation from Congress.

Critical Month for Lead

If the lead price holds at 13 cents through February without a cut there's a good chance it can remain stable for some time. Demand for lead is usually light in the first months of the year when battery manufacturers and construction men mark time until spring. While lead demand and supply are in fair balance, certainly better than with zinc, sales volume continues on the low side. Indicative of this was the cut of $4 per ton for the metal in California to bring the price to the St. Louis equivalent of 12.8 cents per lb and stimulate consumption.

Lead scrap supplies are large and smelters advanced their fee for smelting battery plates by $5 to $70 per ton. Foreign metal began to appear again at price concessions in mid-February. Nevertheless the rate of imports has fallen off appreciably from the 1953 average.

Historically lead and zinc sell within a small differential of each other. The present differential of 3½ cents per lb in favor of lead appears out of line. It is reasonable to expect this to lessen in 1954.

Proposed Tin Agreement To Stabilize Price

The Tin Agreement comes up for ratification in the second quarter. Both Government and industry meetings will be held to determine whether Washington should ratify it. It amounts to whether the Administration should endorse a foreign cartel with price fixing and buffer stocks to stabilize the market.

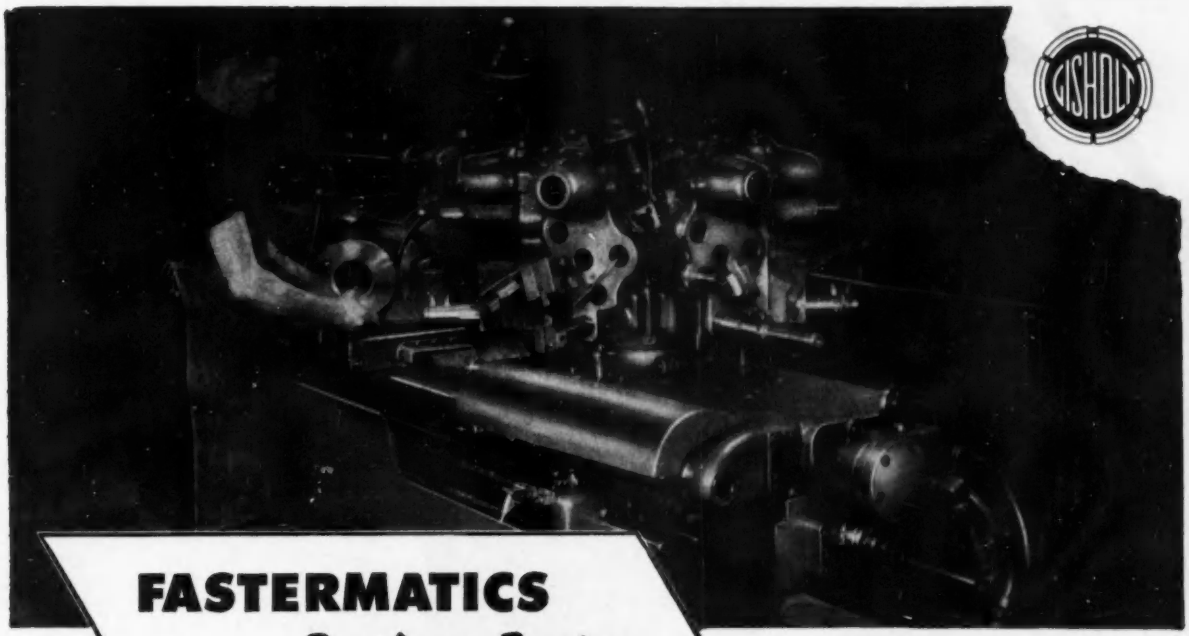
If the Agreement is ratified—and this can be done even if the United States refuses to go along—it would mean a price range between 83 cents and $1.13 per lb for Straits tin in New York. This compares with a present price of 85 cents. This price affords meager profits for even the low-cost Malayan producers and affords none at all for Bolivia. Political aims may sway sentiment fully as much as economic in determining whether this country should support the Agreement and lend its support for a higher tin price.

Without the Agreement the price probably will go lower, particularly if Washington should decide to offer its over-supply of tin on the market. The national stockpile is said to be adequate for any emergency.

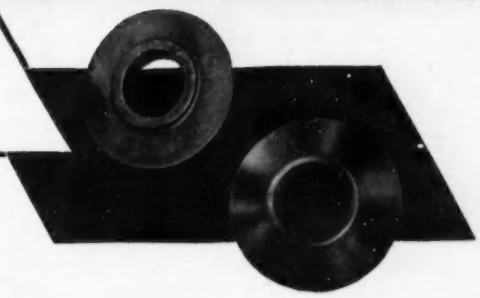
Power Steering Wins Broad Acceptance

Some indication of the growing acceptance of hydraulic power steering may be gained from information supplied by the Saginaw Steering Gear Div. of General Motors Corp. As of January, the division had shipped a grand total of 825,523 units since the introduction of its power steering gear.

The above figure includes both integral and linkage booster types for all applications, including passenger cars, trucks, and other equipment. With the completion of its expansion program, Saginaw anticipates a total volume of production of at least one million units by April.



FASTERMATICS
Produce Faster—Pay Off Faster

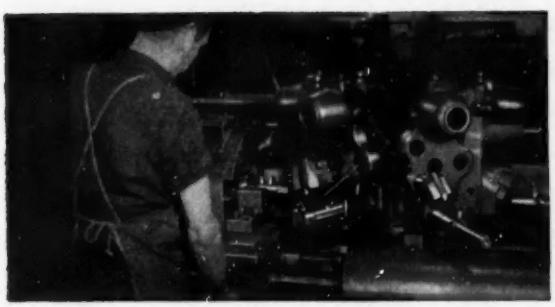


It may seem incredible, in this day and age, for any major machine tool to "buy" itself in nine short weeks of operation. But that's exactly what the Fastermatic Automatic Turret Lathe did on this job of machining clutch plate hubs.

Former time, on hand-operated turret lathes, was 15 minutes per piece. The Fastermatic, with automatic control of all machine functions, reduced the time to only 3 minutes, floor to floor.

Earnings piled up so fast over former production costs that the Fastermatic paid for itself in just 9 weeks—or 893 hours of operation.

Do you have work that permits a number of cuts in one chucking? Investigate the Fastermatics. You may have a big opportunity to increase production, cut costs and save man power.



In this tooling setup, only 3 turret faces are needed to turn each part. With duplicate tooling on the remaining 3 faces of the hexagon turret, 2 parts are machined with each complete turret cycle. The operator merely loads and unloads the work.

THE GISHOLT ROUND TABLE *represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.*

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

News of the AUTOMOTIVE AND AVIATION INDUSTRIES

Continued from Page 20

ACF-Brill, Twin Coach Subjects of New Reports

At presstime, two significant, although unconfirmed, reports were circulating regarding ACF-Brill Motors Co. One was to the effect that the company's bus iterests had been sold to Twin Coach Co. for an undisclosed sum. Accompanying it was a corollary report that this was a step to possible liquidation of ACF-Brill, once its current defense contracts have been fulfilled. ACF-Brill officials declined comment on these reports.

These speculations followed closely on the heels of an announcement that ACF-Brill had agreed to sell its 30-acre Philadelphia plant to the Penn Fruit Co., a supermarket chain, for a price said to be in the neighborhood of $2 million. The former plans to lease back a portion of the facility to carry on its existing business, mainly defense work. In recent months the company has been operating the plant at about 30 per cent of capacity.

De Soto to Add New Model to Line Soon

De Soto has told its field organization that it will add a new "high fashion" model to its line soon. The car is expected to be announced sometime in the spring.

PLASTIC TOP CHRYSLER

La Comtesse, new Chrysler plastic top car, is built on a New Yorker De Luxe Newport chassis. It is powered by a 235-hp Fire Power V-8 engine.

Eaton Mfg. Co. Buys Spring Perch Co.

Eaton Mfg. Co. has acquired Spring Perch Co. of Lackawanna, N. Y., producer of chassis springs used in trucks. The New York company will be operated as a division of Eaton and will be improved and expanded to take care of future requirements beyond the capacity of Eaton's Spring Div. at Detroit, which manufactures leaf and coil chassis springs.

President of the new division will be F. I. Goodrich, general manager of the Springs Div. at Detroit. E. H. Lindeman, manager of the Leaf Spring Dept., will be vice-president. J. E. Fawcett is general manager.

Hudson Aircraft Parts Contract is Extended

A new defense contract which is expected to "sustain" the firm's defense production and employment until 1955 has been granted to Hudson Motor Car Co. The contract, amounting to "many millions of dollars," was awarded by the Glenn L. Martin Co. It calls for "substantial additional quantities" of airframe components for the B-57 Night Intruder bomber.

According to spokesmen of the car company, the new commitment to Hudson is about 90 per cent of its existing contract with Martin. Hudson has been turning out fuselage sections and tail empennages for the B-57 bomber in its various model versions since the start of the Martin program. The latest contract replaces the letter of intent under which Hudson initiated production programming and material procurement for additional units last October.

Dodge Offers Power Brakes as Option

Dodge soon will offer power brakes on all models as optional equipment. The brake is the Kelsey-Hayes unit, now being offered on Chrysler and De Soto, and provides mechanical brakes if the power fails.

Continued on Page 74

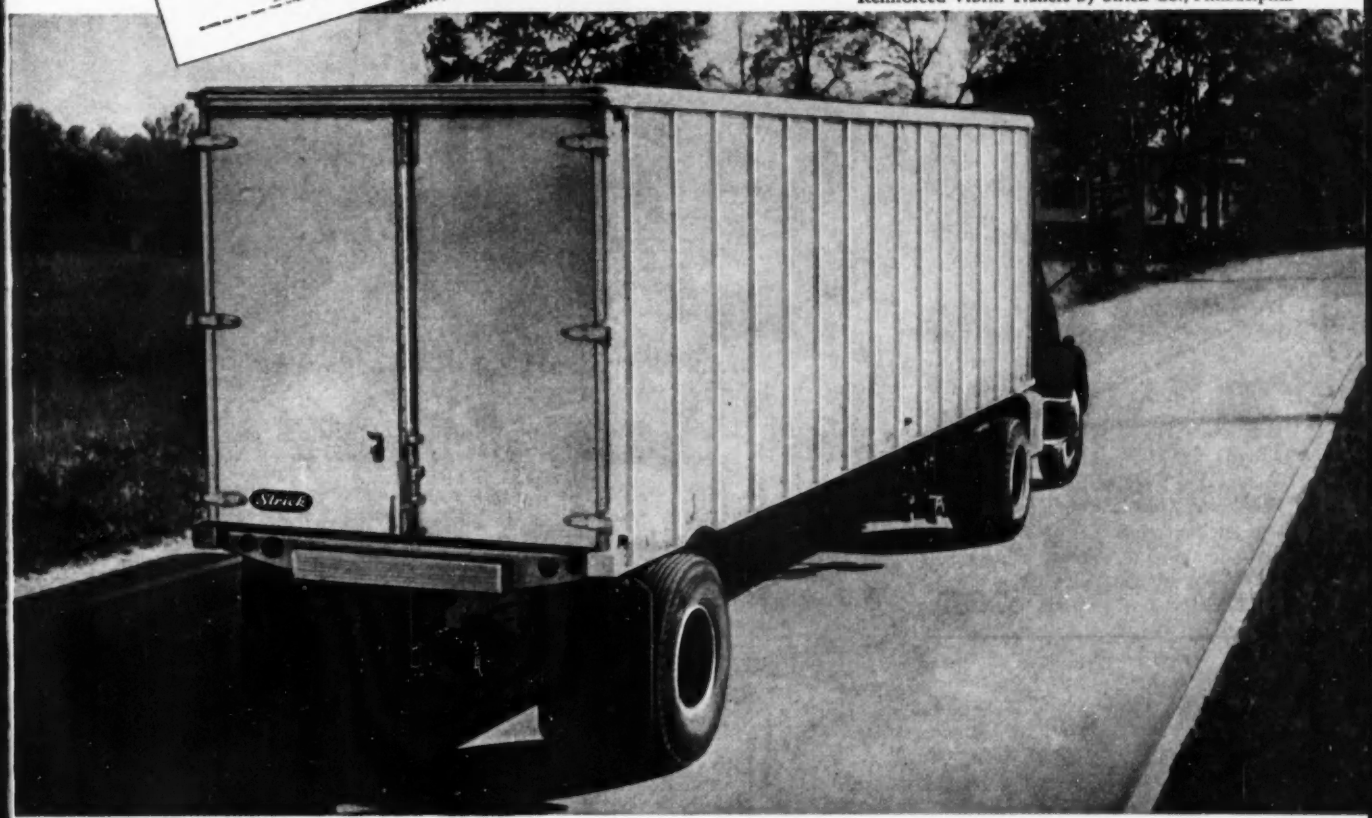
REGIONAL SALES OF NEW PASSENGER CARS

Zone	Region	December 1953	November 1953	December 1952	Twelve Months 1953	Twelve Months 1952	Per Cent Change: Dec. over November	Per Cent Change: Dec. over Dec. 1952	Per Cent Change: Twelve Months 1953 over 1952
1	New England	20,026	27,000	20,341	329,519	238,870	−25.83	− 1.55	+37.95
2	Middle Atlantic	79,091	83,204	81,715	1,109,162	793,847	− 4.94	− 3.21	+39.72
3	South Atlantic	53,004	57,269	48,296	664,688	491,282	− 7.45	+ 9.74	+35.30
4	East North Central	101,723	120,531	102,674	1,503,850	1,060,581	−18.82	− .93	+41.79
5	East South Central	22,884	24,877	18,942	277,046	195,897	− 8.01	+20.81	+41.43
6	West North Central	41,443	43,833	33,876	571,507	402,934	− 5.45	+22.33	+41.84
7	West South Central	45,228	37,927	33,367	518,964	377,208	+19.25	+35.55	+37.58
8	Mountain	13,094	14,828	13,400	182,424	143,182	−11.69	− 2.28	+27.41
9	Pacific	37,444	40,842	47,291	581,829	454,593	− 8.32	−20.82	+27.99
	Total—United States	413,937	450,311	399,906	5,738,989	4,158,394	− 8.08	+ 3.51	+38.01

States comprising the various regions are:—Zone 1; Conn., Me., Mass., N. H., R. I., Vt.—Zone 2; N. J., N. Y., Pa.—Zone 3; Del., D. of C., Fla., Ga., Md., N. C., S. C., Va., W. Va.—Zone 4; Ill., Ind., Mich., Ohio, Wis.—Zone 5; Ala., Ky., Miss., Tenn. —Zone 6; Iowa, Kan., Minn., Mo., N. D., S. D.—Zone 7; Ark., La., Okla., Tex.—Zone 8; Ariz., Colo., Ida., Mont., Nev., N. M., Utah, Wyo.—Zone 9; Cal., Ore., Wash.

and now...Vibrin *Plastic Trailers!*

Reinforced Vibrin Trailers by Strick Co., Philadelphia



Less than two years ago, Naugatuck first announced a dent-proof, rust-proof **car body** of Vibrin polyester and glass fibers. Now this amazing reinforced plastic is being used to construct heavy-duty **truck trailers!**

Strong yet light! Riveted to a light metal skeleton, Vibrin glass-fiber panels are unharmed by severe impacts of loading, unloading, and road shock. They won't warp, shrink, or lose their fit. They eliminate heat-leaking joints in refrigerated trailers. **And they save up to 1000 lbs. in weight!**

Extremely corrosion-resistant! Vibrin trailer bodies can't rust—won't rot, become contaminated, or swell, even under steam cleaning.

Translucent, too! Unpigmented roof panels allow enough light to read shipping labels—**make loading and unloading far easier!**

No wonder more and more manufacturers everywhere are swinging to Vibrin. In boat hulls, auto bodies, machine housings, structural paneling, and many other applications, it's leading the way to newer, finer, more efficient products.

Why not reinforced Vibrin® for milk and ice cream carriers, box car interiors, house trailers, storage refrigerators—**wherever** corrosion or leakage poses a problem? See how this singularly strong, light, and corrosion-resistant plastic material can put **you** on the road to profits.

For further information write on your letterhead to the address below.

Naugatuck Chemical

Division of United States Rubber Company

523 ELM STREET, NAUGATUCK, CONNECTICUT

BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • **IN CANADA:** Naugatuck Chemicals, Elmira, Ontario

News of the AUTOMOTIVE AND AVIATION INDUSTRIES

Continued from Page 72

Car Dealers Ask NLRB Exemption

The National Automobile Dealers Association, which has long been in a tussle with the National Labor Relations Board, is urging Congress to exempt new car dealers and other local retail businesses from the provisions of the Taft-Hartley Law.

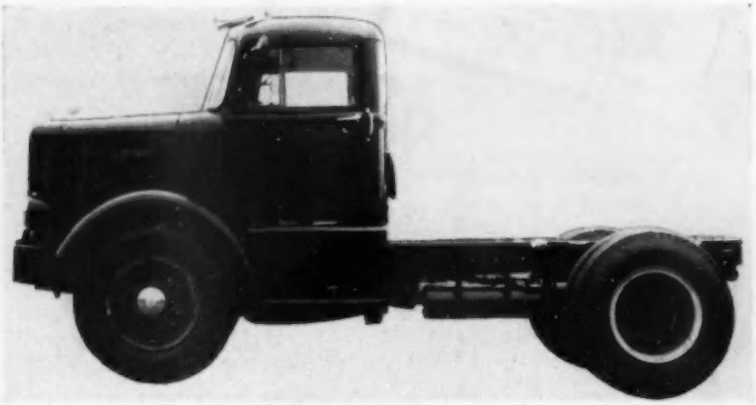
James C. Moore, general counsel for NADA, said in a statement before the Senate Committee on Labor and Public Welfare, that the NLRB should not have jurisdiction over local retailers. Citing a case involving nine automobile dealers in Bogalusa, La., Mr. Moore said that, although employees voted against a union, the dealerships were still being picketed. He added that the unions, through the picketing, were attempting to coerce employers to force their workers to join against their will.

While the dealers have been seeking relief from NLRB and Louisiana courts to end the picketing, their efforts have been futile, Mr. Moore stated. The courts claim that they are powerless to grant any injunctions against this kind of picketing, and NLRB feels it doesn't have the jurisdictional authority, he concluded in summarizing.

New Car Sales in 1953 Second Highest Ever

Final new passenger car registrations for last year reveal that 5,738,989 cars were sold, the second highest sales year on record. The previous high was set in 1950, when more than 6.3 million new cars were sold. Sales in 1953 exceeded those of 1952 by more than 1.5 million cars.

June was the peak month last year with 542,193 cars sold. December registrations totaled 413,937 units, third lowest month of the year. However, the fourth quarter total of more than 1.3 million new cars sold made it the second best quarter of the year.



SHORTER TRACTOR FOR LONGER TRAILERS

Known as the new DCU-75TN, this new Autocar Diesel tractor has been shortened in length to 106 in. from 123 in. on the conventional model. Simultaneously, the latter's 142-in. wheelbase has been cut to 131 in. on this model. It comes equipped with Diesel engines up to 200 hp, according to the manufacturer.

Hudson Cuts Price Of Power Steering

Following the general trend of other car manufacturers, Hudson Motor Car Co. has reduced prices on its power steering units for three of its 1954 cars. Formerly carrying a list price of $177.38, power steering will now be available at $142.04 for the Wasp and Super Wasp and $150.08 for the Hornet, including Federal excise tax.

Curtiss-Wright May Buy Mich. Jet Engine Plant

Curtiss-Wright Corp. may take over the $50 million jet engine plant at Romulus, Mich., built by Lincoln-Mercury Div. of Ford Motor Co. for the Navy. L-M originally had planned to build jet engines there, but the contract was cancelled before the plant could get into production.

Curtiss-Wright would like to have the plant for production of either J-65 or J-67 engines, and the Navy is reported ready to approve the sale. However, a hitch has developed because the Air Force, a prime Curtiss customer, prefers that the company use one of its own surplus plants. An idle plant at Chicago has been suggested by the Air Force as a likely one for the Curtiss operation.

The Romulus plant is on a 150 acre site, and has 500,000 sq ft of floor area and 19 test cells. It now is being used for storage of machine tools under the Navy's industrial reserve program.

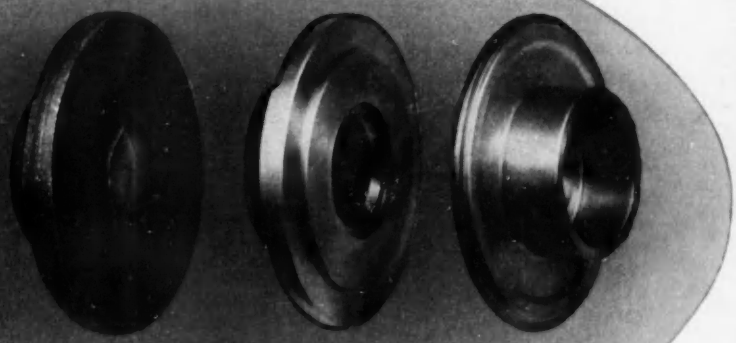
Ford of Canada to Build Parts, Accessories Unit

Construction by Ford Motor Co. of Canada, Ltd., of a $1 million parts and accessories depot in Regina has been announced. This latest addition to the company's $87 million expansion program will be started on a 10-acre site early this spring and will have 60,000 sq ft of floor space.

March 24 Set for Vote On Nash-Hudson Deal

Stockholders of Hudson Motor Car Co. and Nash-Kelvinator Corp. will vote March 24 on approving the proposed consolidation of Hudson and Nash into a new corporation to be called American Motors Corp. A two-thirds approval vote is required by stockholders of both companies before the proposal can become effective.

at one of the world's largest automotive plants 37¼ seconds for 28 operations



JOB FACTS:

PART.....Torque Impeller Hub.
SIZE.....4" diam. 1¼" long.
MATERIAL.....Steel forging. SAE 1146 annealed
MACHINES: 6 inch model RPA-8 Acme-Gridley Chucking Automatics.

1ST MACHINE, with double index and duplicate tooling finishes 2 pieces per cycle—each with 11 identical operations. All carbide tooled.

Machine Time: 22½ seconds—320 per hour.

2ND MACHINE, single index with one set of tools completes opposite side to 17 operations. All carbide tooled.

Machine Time: 26 seconds—138 per hour.

WITH 100% CARBIDE TOOLING ON 8-SPINDLE

Acme-Gridley Chucking Automatics

IN this most competitive big business all planning must be toward higher consumer acceptance in both quality and purchase price—and leave a profit for the effort.

All three of these prime essentials begin with small parts such as these and hundreds of others made on multiple spindle chucking automatics.

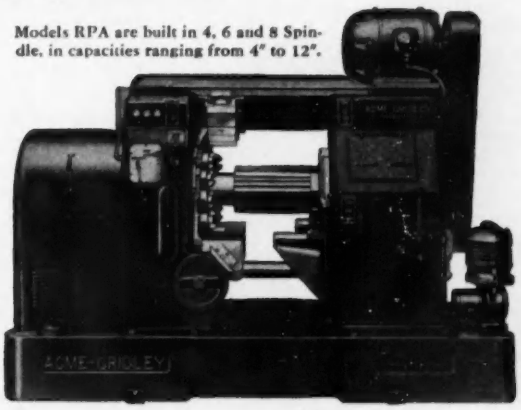
Alert, continuous and critical study is given to the most minute detail for manufacturing improvements, accepting only those which will:

- **save a fractional second in time per piece**
- **avoid rehandling on extra machines**
- **release valuable floor space**
- **relieve costly man-hours for other work**

—all to the end of achieving better components at lowered factory cost.

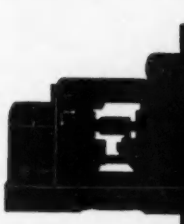
For more than 20 years Acme-Gridley machine design engineers and tooling specialists have helped meet these vital needs—by improving basic machine stamina, by ingenious applications of fastest cutting carbide tools, by simplifying operator effort. All of which applies to multiple chucking operations and to bar machine performance.

Models RPA are built in 4, 6 and 8 Spindle, in capacities ranging from 4" to 12".



Regardless of the particular kind of mass production parts, let us show you how to put Acme-Gridleys to work in your plant—MORE PROFITABLY.

Remember—your market also must be protected against competition if you expect to make a profit.



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ACME-GRIDLEY BAR and CHUCKING AUTOMATICS
1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • Limit, Motor Starter and Control Station Switches • Solenoids • Contract Manufacturing

CALENDAR

OF COMING SHOWS AND MEETINGS

American Society for Testing Materials, spring meeting, Shoreham Hotel, Wash., D. C. .....March 1-5

SAE National Passenger Car, Body, and Materials Meeting, Hotel Statler, Detroit, Mich. .....March 2-4

American Society for Metals, midwinter meeting, Hotel Statler, Boston, Mass. .....March 4-5

A.M.A. General Management Conference, Fairmont Hotel, San Francisco, Calif. .....March 9-12

ASME International Meeting, Hotel Del Prado, Mexico City..March 10-12

Geneva Automobile & Truck Show, Geneva, Switzerland .....Mar. 11-21

Chicago Automobile Show, Chicago, Ill. .....March 13-21

National Association of Corrosion Engineers, annual meeting, Kansas City, Mo. .....March 15-19

NAM Institute on Industrial Relations, Hollywood Beach Hotel, Hollywood, Fla. .....March 15-19

American Society of Lubrication Engineers, annual meeting and exhibit, Netherland-Plaza Hotel, Cincinnati, O. .....April 5-7

National Packaging Exhibition, Convention Hall, Atlantic City, N. J. .....April 5-8

Easter Parade of Stars Automobile Show, Waldorf-Astoria Hotel, New York, N. Y. .....April 6-11

SAE National Aeronautic Meeting, Statler Hotel, New York, N. Y. .....April 12-15

Society for Experimental Stress Analysis, spring meeting, Netherlands Plaza Hotel, Cincinnati, O. .....April 14-16

International Motor Show, Turin, Italy .....April 21-May 2

Metal Powder Show and Annual Meeting, Drake Hotel, Chicago, Ill. .....April 26-28

ASTE Industrial Exposition, Philadelphia, Pa. .....April 26-30

American Welding Society, spring technical meeting, Hotel Statler, Buffalo, N. Y. .....May 4-7

International Aviation Trade Show, New York, N. Y. .....May 5-7

Annual Foundry Congress and Show, Cleveland, Ohio .....May 8-14

Vickers Production Machine Tool Forum, Park Shelton Hotel, Detroit, Mich. .....May 11-12

Basic Materials Exposition, Chicago, Ill. .....May 17-20

Canadian International Trade Fair, Toronto, Canada ....May 31-June 11

SAE Summer Meeting, Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J. .....June 6-11

Society of the Plastics Industry, Sixth National Exposition, Cleveland, O. .....June 7-11

American Society for Testing Materials, annual meeting, Sherman Hotel, Chicago, Ill. .....June 13-18

Ford Studies Metals For Atomic Uses

Ford Motor Co., which last year joined with 26 other industrial firms working to harness atomic energy for industrial uses, has revealed it is now doing research on metals which would withstand the terrific heat of atomic reaction.

Purpose of the 27-member research group, headed by Dow Chemical Co. and the Detroit Edison Co., is to develop an electric power plant which could harness this energy. Ford's objective in the project is to try to develop new types of metals which could be used in car manufacture. Ford, which has shown interest in atomic energy for some time, is the only car manufacturer in the group at present.

SHORTIES

Nineteen per cent of our nation's roads carry 81 per cent of present-day traffic.

•

A supersonic fighter carries rockets that streak towards their targets at more than 2000 mph.

•

Two million men and women are engaged in the oil business.

Eaton Automatic Drive

(*Continued from page* 51)

ernor and accelerator pedal position are met in the second gear ratio, the low clutch is de-energized and the high clutch is energized. As pointed out, the high clutch drives through the transmission main shaft, thereby providing a direct drive. All upshifts are very smooth due to clutch action as there is no sudden change in torque during the gear changes even though under wide open throttle operation. This is made possible by the unique characteristics of these clutches as they can be controlled to take care of any type of shifting conditions and absorb all shock.

Downshifts are in the reverse order of the upshift operational phase. A kickdown arrangement has been provided which is operated by depressing the accelerator pedal past the wide open throttle position. This overrides the governor up to a certain predetermined speed and thereby causes the downshift.

When using the D2 position, there is no mechanical shifting in the transmission since second gear is by-passed (except for kickdown). In first, the low clutch is energized and in direct the high clutch is energized; thus, only electrical current is utilized for the operation. Actually, one clutch is energized just before the other releases so that the engine does not race during the ratio change.

In the L or low position of the selector lever, the transmission shifts between first and second only. This position is used for descending hills, or other driving conditions where it is not desirable to use high speed direct ratio.

To engage reverse gear, movement of the selector lever de-energizes the magnetic clutches and moves the shifter flange which locks first gear to the main shaft. The shifter flange is moved rearward until its outer gear teeth engage the reverse idler gear. When engagement is completed, electric current is fed by the accelerator pedal to the low magnetic clutch which powers the countershaft.

When the selector lever is in neutral low gear is engaged but no current can be fed to either of the magnetic clutches.

In addition to the type of transmission covered, many gear arrangements are possible—if four speeds are desired, an overdrive can be added.

Another arrangement which would eliminate the clutch pedal and provide a semi-automatic transmission would be to use a single magnetic clutch with a conventional transmission. A switch on the gear shift lever would provide a clutch disengagement during shifting. Eaton believes that this might be a logical step for low-priced cars, European cars, and fleet users such as taxicab companies. Because of the clutch, the vehicle can be started in any gear without stalling the engine.

Engineers at Eaton claim that there is practically no drag and that wear is negligible in the new dry powder magnetic clutches. The use of these clutches for car fan drives and air conditioning equipment will be covered in forthcoming issues of AUTOMOTIVE INDUSTRIES.

Mon!—there's thrift!

You can Save time . . . trouble . . . money with J&L Wide Cold Rolled Flats

J&L Wide Cold Rolled Flats save you time, trouble, and money in replacing forgings, expensive castings, or parts ordinarily made from hot rolled plates planed to size.

In such applications as stripper plates, backing plates for dies, die plates, punch pads, jigs and fixtures, plate and die molds, pattern plates, and other machinery parts J&L Cold Rolled Flats offer the following outstanding advantages:

1. THEY REQUIRE LESS MACHINING (they are true to size and section).
2. THEY NEED LESS FINISHING (they have a smooth, cold rolled surface).
3. THEY ELIMINATE FABRICATING OPERATIONS (they are available in a wide range of widths and thicknesses).

RANGE OF SIZES: Widths—up to 14½" Thickness—⅛" to 2"

Order J&L Wide Cold Rolled Flats from your local J&L Distributor.

J&L STEEL

Jones & Laughlin
STEEL CORPORATION — *Pittsburgh*

Ford Engine Plant

(*Continued from page* 30)

valve seats, valve throats, and valve seat faces.

By automation the work proceeds to a battery of five rows of 27-station W. F. & John Barnes transfer machines. With 77 spindles in action, they drill, counterbore, ream, and tap holes in intake and exhaust faces, spark plug holes, rocker arm mounting bracket holes, and end holes. At Station 8 the work is rotated to dump chips; the right hand head at Station 9 inspects holes in intake port faces; the left hand head at Station 19 inspects 13 holes; Station 18 automatically indexes the work by 90 deg; the right hand head at Station 23 blows out chips and checks one hole; Station 26 automatically indexes the work 90 deg for the next operation.

Final major operation is the surface broaching of the gasket face to remove all scratches and nicks accumulated during machining as well as to provide a fine finished face to the required tolerances. Surface broaching is done in tunnel type LaPointe machines, similar to the equipment on the block. Only four of these LaPointes are required to handle the volume.

Only again a battery of special Expert machines, served by automation, is employed for pressing-in Welch plugs. From the Expert machines the heads proceed to the air test for tightness. Cylinder heads are washed in a long horizontal Solventol machine, unique because of the provisions of automation for loading and unloading, the work riding through the machine on an inclined conveyor. As the heads leave the exit end of the washer, they are picked off and loaded onto a conveyor leading to inspection. One of the principal operations here is the checking of bores, using a large battery of Sheffield Precisionaire gages.

Cylinder head assembly, consisting of the installation of valves, springs, retainers, etc., is handled in an extremely rapid cycle of events in a special assembly machine designed on the principle of complete automation. As illustrated, it consists, essentially, of the large indexing table, having six stations and two assembly heads in the foreground. In operation, the fixtures on the indexing table are kept loaded with the loose parts required for assembly. The cylinder head, meanwhile, is fed into the head mounted in the background. At timed intervals the head is elevated in its fixture, then moved horizontally outward in position over the fixture on the table. At the same time the fixture moves downward and unloads the head over the loaded fixture on the table. As the table continues to index, the work reaches the heads where the valve assembly is pressed securely in place.

THE SINKING FACTORY

(*Continued from page* 35)

area, which has sunk 17 ft to date, and is expected to reach the 22-ft level by 1967. During '51-'52, this area submerged 2.2 ft, compared to Ford's 1 ft (plus).

Surprisingly enough, subsidence has not affected conveyors, machine tools, etc., to a degree worthy of note. In other words, subsidence thus far experienced has been sufficiently uniform within the manufacturing areas to preclude the possibility of major distortions, misalignment, or breakage of such facilities being definitely or directly attributable to subsidence activity.

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Light Alloy Forgings

(*Continued from page* 56)

It must be brought out that some forging designs could be of such a nature that six months could conceivably be required for the construction of a set of finisher dies only, assuming that a die sinking machine is utilized eight hours a day for six days a week. If the complexity of the design is such that two or more blocking dies would be required to produce the forging, it would necessitate a large die sinking machine for each operational die and the utilization of each machine would be consumed for practically six months. With all the aircraft companies going to larger and closer toleranced forgings, it is apparent that a sufficient number of large machines will have to be constructed so that necessary die sinking capacity will be available. This, added to the procurement time of die blocks, will extend delivery of forgings far beyond anything which we have known to date.

The sooner dies can be designed and constructed for the large presses, the quicker we will all obtain experience in fabricating large forgings. By the same token, the sooner we design forgings for the large presses, the sooner machine tool builders will design and construct machines for sinking large dies.

The machining of large forgings has developed a great deal of discussion in connection with the Heavy Press Program with considerable controversy and difference of opinion. Discussion here is confined entirely to what has been called "in-process machining." This involves such intermediate machine operations as the forging producer uses to produce his finished forgings. It is not meant to include, for instance, the reduction of web thicknesses down to dimensions of 0.060 in. to 0.090 in. Such operations represent an entirely different problem.

"In-process machining," for example, refers to machining operations necessary to reduce massive sections so as to obtain effective heat treatment of 75S and 14S forgings to the T6 condition. The possibility of machining webs and fillets in "boxed-in" sections between forging operations in order to reduce unit pressures required in producing forgings to desired size is also suggested. This might be economical particularly in short runs.

During the machining of aluminum alloy forgings unexpected changes

Above and beyond the *quality* you require in your cable and wiring assemblies, it is important to choose a manufacturer who can give you such *plus advantages* as experienced engineering counsel and on-time delivery. Often it is intangibles such as these that help keep your production lines going.

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The wide use of Packard cable and wiring assemblies on America's foremost automotive vehicles, aircraft and appliances is your assurance of top quality. Packard's vast manufacturing capacity—more than 7,000,000 feet of finished cable and 800,000 wiring assemblies each day—is your assurance of regular delivery in any quantity you demand. And Packard's engineering ability assures cable and wiring assemblies correctly designed and fabricated to suit your requirements. These are factors that often result in worthwhile savings to Packard customers.

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AUTOMOTIVE, AVIATION AND APPLIANCE WIRING

sometimes occur in dimensions. Such dimensional changes may be due to localized overheating during machining of the part, redistribution or relieval of residual stresses imposed during heat treatment and, perhaps most important, exceeding the yield strength of the part by improper chucking or machining fixtures. The changes can also result through excessive loading of the part at the tool tip because of insufficient support.

The necessity of minimizing residual stresses caused by heat treatment is recognized by Alcoa and much thought has been given and will continue to be given, to this matter. Investigations conducted have shown that the proper sequence of machining operations is a great aid in equalizing the relieval of residual stresses. Compressive residual stresses, generally located at the surface of a forging, are balanced by tensile stresses in the interior part of the forging. Removal of the compressive stresses by alternate machining on both sides of a forging will greatly assist in holding distortion to a minimum.

It should be emphasized in conclusion, the vital importance in this heavy forging press program of cooperation between aircraft designers and forging producers as the only means by which the objectives of the program may be achieved and its enormous cost justified. These objectives cannot be reached in a short time but will require sustained efforts over a long period. The progress made during the past 10 or 15 years in the light alloy forging industry has been a key factor in the development of the American aircraft standards as they are known today. The promise for the future is even greater, and it is a promise which must be realized.

Laminated Plastic Tooling

(*Continued from page* 48)

plastics, GAC engineers recommend the use of self-tapping screws or inserts.

Although very often the contour and shape of the reinforced plastic tooling has sufficient rigidity for the job involved, it is sometimes necessary to provide additional structural strength to the tooling for specialized operations. To obtain additional rigidity, GAC uses molded-in steel tubing or glass fiber tubing, laminated plastic channel or angle sections, sandwich construction, or glass fiber egg crate construction.

For the most part, GAC is utilizing Ren-ite resins made by Renaud Plastics, Inc., for its plastic tooling. This material, when laminated with a plain weave glass fiber cloth 0.013 in. thick which has average breaking strength of 430 lb per in., is said to have the following properties:

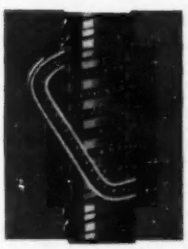
Tensile strength	20,000 psi
Compressive strength	25,000 psi
Flexual strength	40,000 psi
Flexual modulus	2.3×10^6 psi
Izod impact—notched	18.61 ft lb/in notch
Rockwell hardness—M scale	98.5

According to company engineers, when the material is formed at pressures higher than atmospheric and with very closely controlled resin-to-glass ratios, it provides higher physical performance than that given in the preceding table.

When drill bushings are used, one of the techniques is to employ a standard commercial bushing which is pressed into a drilled steel block having a central flange. These blocks are attached to the model surface by the most expedient means. The plastic and glass fiber material is then laminated around the bushing and blocks until the proper thickness is obtained. GAC is consistently developing new techniques to this end.

The way we change angles on 'Copter Blades

puts a brand new slant on controlling power



One of these days, when you hop from home to the office in your personal helicopter, you'll marvel at the way you "shift gears"... from "straight up" to "full speed ahead"... from "sidewinder" to "hover". It will be done fast, smoothly, accurately.

Today, helicopter builders are using Cleveland Pneumatic's friction-less combination of a screw and some balls to adjust the angle of the whirling blades on the 'copter. This device is called a "ball-screw actuator".

Ball-screw actuators are useful in many applications in either of two ways... to multiply the power of a drive... or to increase its speed. You also get the hair's-breadth accuracy of a metal-to-metal drive that eliminates merely-approximate positioning of other systems.

Somewhere in your product or your idea for a product, you may be able to use Cleveland Pneumatic ball-screw actuators. They've been engineered by us in all sizes... from tiny ones for 'copter blades to the giants that we make to raise and lower bomber landing gears.

If you wish to know more about Cleveland Pneumatic, write for our 16-page booklet.

Cleveland Pneumatic
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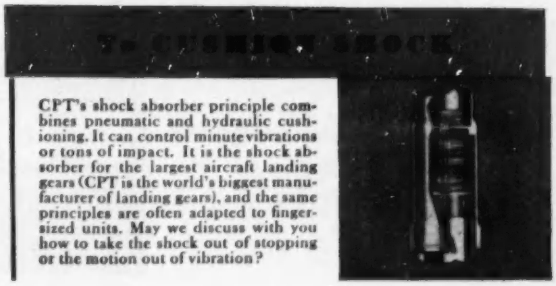
Department G-3

BALL-SCREW ACTUATORS • AUTOMOTIVE SHOP EQUIPMENT
AIR-OIL IMPACT ABSORBERS

World's Largest Manufacturer of Aircraft Landing Gears



CPT's shock absorber principle combines pneumatic and hydraulic cushioning. It can control minute vibrations or tons of impact. It is the shock absorber for the largest aircraft landing gears (CPT is the world's biggest manufacturer of landing gears), and the same principles are often adapted to finger-sized units. May we discuss with you how to take the shock out of stopping or the motion out of vibration?

Engineering Developments

(*Continued from page* 45)

Small engines are mostly mass-produced, and their manufacturers have felt in the past that it would be cheaper to add to the number of cylinders, or otherwise increase the engine displacement, than it would be to turbocharge. This attitude was probably correct when turbocharging yielded output gains of 25 or not more than 50 per cent, and when the power-weight ratio of the engine was not nearly as important a factor as it is rapidly becoming today. Furthermore, turbochargers in diminutive sizes until recently were either unavailable or prohibitively expensive, and—even more important—their performance was not good enough to bring about the startling increase in engine output and improvements in engine performance that have been achieved for medium-sized and large heavy-duty engines.

Today, however, the art of making highly-efficient small turbochargers, capable of high pressure ratios and so designed that they lend themselves to low-cost production, is rapidly being mastered. This should start a trend toward turbocharging relatively small engines—engines which in many respects are even better suited for high-pressure turbocharging than are their larger counterparts. This suitability can permit high-pressure turbocharging to bring about increases in the outputs of small engines, improvements in their fuel consumption, and reductions (on a "per bhp" basis) in weight, size and manufacturing cost of a magnitude which may seem visionary to some at this moment. Last, but not least, high-pressure turbocharging can be made to cause greatly increased torque at low engine rpm, thereby making the piston engine far more suitable for service in road and off-highway vehicles—one of its major fields of application.

Turbocharging and the Future of the Piston Engine

The rapid development of the gas turbine has made this new prime mover the most formidable competitor that the internal combustion reciprocating engine has ever had. For example, the gas turbine power plant has, to a large extent, supplanted the reciprocating engine in the field of aircraft propulsion; the many recent installations of gas turbines for driving pipeline compressors, and the serious consideration being given to gas turbines for use in heavy-duty vehicles, are more than "straws in the wind."

The best way in which the reciprocating engine can meet this competition is to appropriate for its own use the desirable features of the gas turbine, at the same time retaining its own inherent advantages. This means compounding the piston engine with the gas turbine, which is achieved in the simplest manner possible by high-pressure-turbocharging.

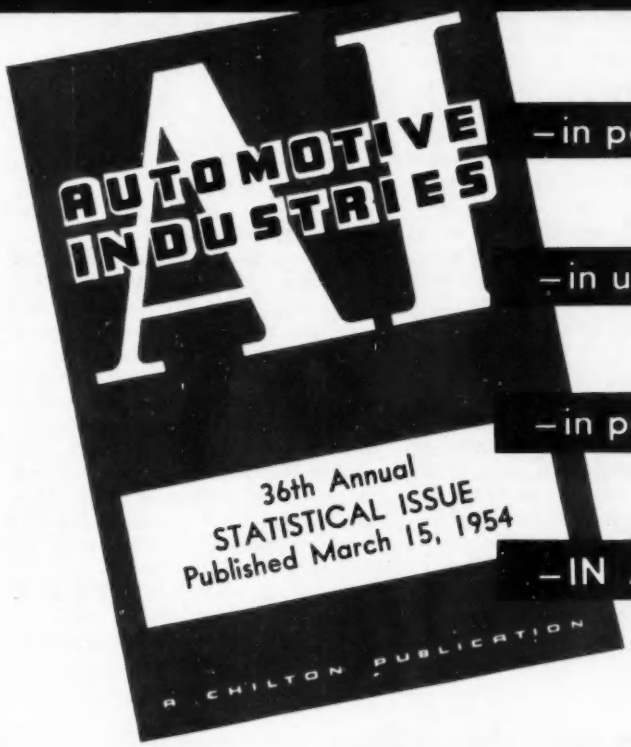
Plastics Meeting

(*Continued from page* 39)

first be boxed in so that the face of the model forms the base of the box. All surfaces must then be coated with a parting agent, such as wax, aluminum foil, etc. The face of the die may now be laid up, using Fiberglas roving or Fiberglas cloth, saturated 50 per cent with polyester resin. The polyester resin to be used for the entire die is all mixed at the same time, using cobalt naphthenate and MEK peroxide as the curing agents.

We have found that the proper

For '54 the AUTOMOTIVE INDUSTRIES 36th Annual Statistical Issue will SET A NEW HIGH



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THE ONLY REFERENCE ISSUE OF ITS KIND

This popular "handbook" is carefully and accurately compiled . . . the data sectionalized into four basic divisions for quick, easy reference. First compiled in 1919, the Statistical Issue is acclaimed as the ONE and ONLY source of data for automotive and aviation design, engineering, production and administrative executives who want authoritative production and registration statistics; specs on cars, trucks, buses, trailers, aircraft, engines; and other useful data.

THE KEY TO A $26.6 BILLION INDUSTRIAL MARKET

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THE NEWS MAGAZINE OF AUTOMOTIVE & AVIATION MANUFACTURING

choice and positioning of parallel strands and cloth is essential to draw die life.

Fixtures

Our Reinforced Plastic Fixture Department is now a very useful and necessary link in the chain of tooling requirements for automotive body work. In the process of tooling up for our last style change a series of reinforced plastic fixtures were submitted and tried out in actual production. Their durability and accuracy were maintained, even after the rough handling required by high production methods. In many cases production was increased due to the compact construction and lighter weight made possible by use of one piece reinforced plastic fixtures.

The cost of reinforced plastic tooling is most cases is only a fraction of the cost of equal tooling made of steel, and the speed with which reinforced plastic fixtures can be produced has assured us of quite an extensive program in the forthcoming style change.

The tests to which these plastic fixtures have been submitted have shown that no single type of construction does satisfactory work for all jobs. Thus, a variety of materials and several processes are required to meet the different qualifications.

Berliet Buses

(*Continued from page* 33)

the belt-driven generator, operates this unit through a twin belt.

Steering is circulating ball type built under Mill patents and is power assisted by compressed air. Optional equipment covers either a 14-in. plate clutch or a hydraulic coupling with a plate clutch, and also the choice between the Berliet five-speed constant mesh gearbox or the Wilson gearbox. A single reduction hypoid rear axle is used, offset in the chassis. Springing is by semi-elliptics front and rear, the front springs having additional leaves coming into action under heavy load, and the rear pair being supplemented by the Gregoire variable ratio diagonally mounted coil springs. Hydraulic shock absorbers are used all round. In certain cases a transverse torsion bar stabilizer is used. All brakes have compressed air application, with engine exhaust brake as optional equipment.

Mullins U.S.A. licenses German firm to use the revolutionary new Mullins Steel Koldflo* Extrusion Process

TODAY—there's a *new way* to make precision cylinders and countless other metal parts. A new process that speeds production—cuts manufacturing costs—and will improve the products *you* make!

Squeezing cold steel into industrial products, long a dream of the metalworking industry, is now a reality!

It's another *first* for Mullins. Another triumph for American engineering skill. It's the truly sensational new MULLINS STEEL *Koldflo* process that literally makes cold steel perform miracles!

Mullins, maker of auto parts and kitchen equipment, has developed *Koldflo—the first workable and practical* process for the mass production of precision metal parts, with glass-smooth surfaces and exacting tolerances.

Already *Koldflo* is outmoding old-fashioned methods with their costly, time-consuming machining, heat treating, grinding and honing operations.

Koldflo turns out one perfect glass-smooth cylinder after another with almost unbelievably exact tolerances!

That's why Kabel und Metallwerke, Neumeyer of Nurnburg, one of the first companies in the world to successfully cold extrude steel, wanted the license to use the *Koldflo* process. That's why they stated: *"This new Mullins process is entirely novel and more advanced than any other we have studied."*

Now, with expanded facilities, supported by Mullins' engineering and development departments—we offer industry complete parts manufacturing facilities using the proved *Koldflo* process.

Write for complete information and descriptive literature. We will gladly demonstrate what *Koldflo* can do for you. Write to Dept. AI-1.

Koldflo **DIVISION**

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MULLINS MANUFACTURING CORPORATION

Salem, Ohio

Accumulator and booster shells for presses

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Accumulators for hydraulic power systems

Lift truck stud-type tilt cylinder shells

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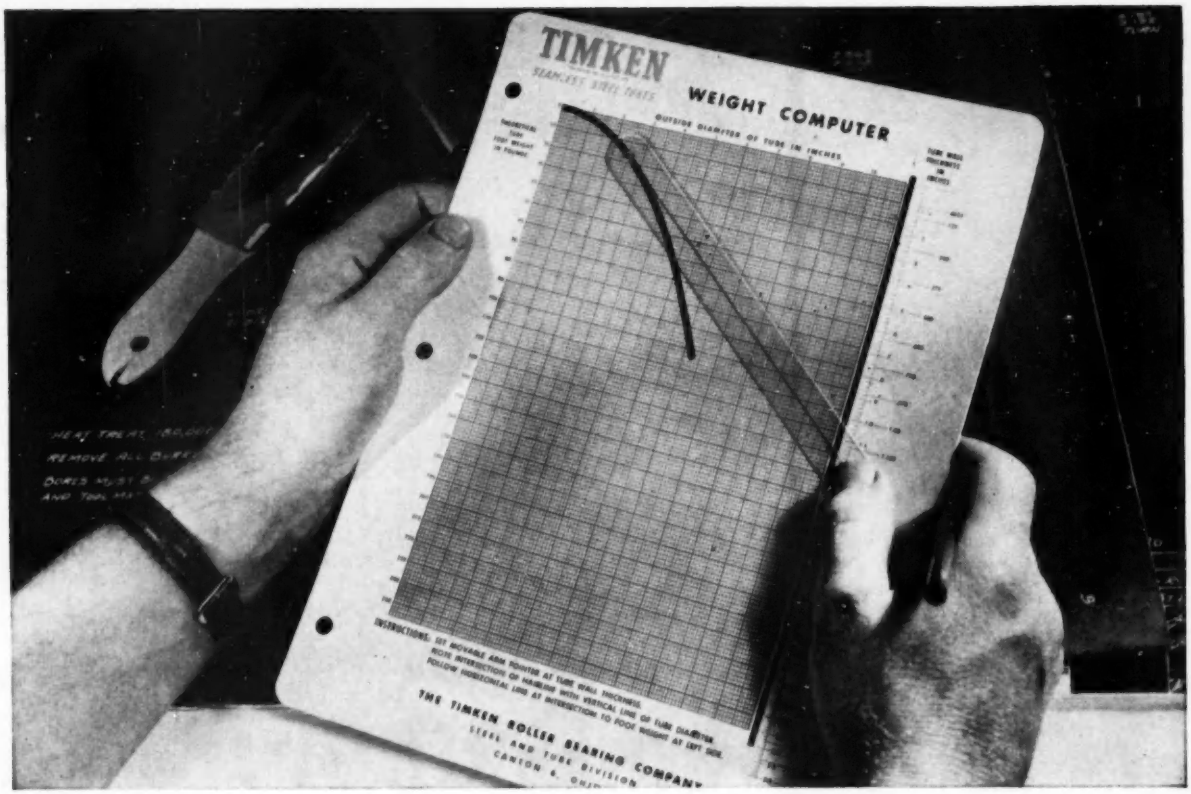

This free computer quickly figures the weight of steel tubing

WITH this handy little computer, you can quickly figure the weight of steel tubing. You set the slide at tube-wall thickness and O.D. and simply read off the tube weight per foot. Write us and we'll send you one. There's no obligation, of course.

This computer is a small example of the helpful service the Timken Company offers manufacturers of hollow steel parts. Even more important: our engineers will be glad to study your problem and recommend the most economical tube size, *guaranteed* to clean up to your dimensions.

Many companies that formerly used bar stock for their hollow parts are making significant savings because they switched to Timken® seamless tubing. In addition to the big reduction in scrap loss, they save a great deal of machining time. Frequently, finish boring is the first production step. Machine tools are released for other jobs.

Timken seamless tubing has fine forged quality because it is made by a piercing process which is basically a forging operation. Write us now on your company letterhead for the handy tube weight computer. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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